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PHYSIOLOGICAL AGE AND SCHOOL ENTRANCE[1]

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INTRODUCTION

Child study has recognized in a general way alternating, or at least differentiated, periods of development, roughly classified according to predominant characteristics, physical and mental, and located with reference to the age of the child in years. Infancy is the term usually applied to the first year or years of life. Following infancy there comes the period of childhood, pretty sharply marked off at the later limit by the characteristics accompanying the attainment of pubescence.

The period of childhood is again variously divided by the different authors, the location of the division points depending upon the characteristics chosen as division marks. Because of the grouping of some important factors about those years at which school is usually begun, it is becoming more general to designate this as a natural division point, or perhaps better, nodal period, of development. The time preceding this nodal period is referred to as "earlier childhood," while the time from this to the appearance of pubescence is referred to as "later childhood." Later childhood, then, be-

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gins approximately at the time of entrance to the graded school and continues up to, or until a short time after, the completion of the graded school work, and might well be characterized as "the age of the grades."

The fact that it does so nearly coincide with the grade school years makes later childhood a most important period from the view points of child study and pedagogy. It is a period deserving of the closest study, especially as regards the child's development and his fitness to succeed in the tasks and cope with the new situations presented in the school environment.

Following a brief characterization of the developmental features at the close of this later childhood period, it is our intention to take up in this paper a somewhat more detailed discussion of those developmental features that group themselves about its beginning. It is our purpose to collect and condense available facts and data from the many investigations that have dealt with particular phases of development in these early years, to relate them in so far as is possible, and to suggest something of their significance.

What we have chosen to call the later limit of childhood is marked by those special phases of development that accompany the attainment of pubescence. It would be useless, for our purpose, to attempt a detailed description of these, though it may be worth while to mention a few of the more important points to which we may wish to refer later.

Very prominent among the physical changes characteristic of the pubescent period is that of growth, both in height and weight. Growth in height shows a remarkable acceleration, extending over several years. The average time for girls is from the tenth or eleventh to the thirteenth or fourteenth year, while for boys it runs from about the eleventh or twelfth to the fifteenth or sixteenth years. Most curves show a similar acceleration in weight following a little later, and occurring also a little earlier in girls than in boys. Both height and weight continue to increase for some time after this rapid acceleration, but at a slower and more uniform rate, so that boys and girls may be said to have almost reached adult size at the close of the rapid pubertal weight increase.

Closely related to these phenomena of general growth, occur rapid growth of certain parts and organs, rapid changes in body proportions, remarkable additions in muscular power, change in quality and increase in quantity of possible mental achievement, and, perhaps most important of all, the attainment of pubescence.

Dr. Crampton, *e. g.*, would seem to give the factor of

pubescence a place of prime importance, since he makes it the basis of grading for "physiological age" during this period (26).

Data with regard to time of eruption of the teeth seem to indicate a close relationship of dentition to the general stage of advancement of development. From tabulations of the number of canines and molars present, Crampton finds a definite correlation of tooth appearance and weight and of tooth appearance and height (26). The more extended investigations of dentition are of interest in this connection also. Boas and Wissler (11), Berten (8), and Röse (77) all found that the eruption of the teeth was earlier, on the average, for girls than for boys. Recalling the fact of earlier pubescence of girls, the suggestion of a relationship between pubescence and dentition, or perhaps better, the relationship of both dentition and pubescence to the general stage of advancement in development, is strong. There is a problem here worthy of further investigation. More knowledge of the relationship of advancement of dentition at this time to other factors of development ought to be very valuable.

Studies of the skeletal development, as worked out by Rotch (80), Pryor (70) and others, while not showing correlations for ossification of any particular part of the skeleton with pubescence, show in a general way a greater rapidity in girls at this stage of life. Great variability in degree of rapidity is also shown, especially by the work of Rotch and Smith (81) and also by that of Pryor indicated above.

Variability in the time of these developmental phenomena is everywhere evident. Tabulations of growth all show that the acceleration extends over several years. Variability is fully as great in dentition, as indicated by the tabulations for time of tooth eruption. Time of appearance of pubescence is also extremely variable. Crampton found this factor appearing in boys from 12.75 to 16.25 years of age.

These main facts concerning the developmental phenomena prominent at the pubescent period are sufficient to indicate that the actual limitation of childhood is not to be referred to a mere temporal reckoning of the length of life, but rather to development. They indicate also that this limit does not coincide with a definitely marked "time line," but rather constitutes a broad "time zone" within which the transition from later childhood over to the earlier stages of the adolescent period is accomplished. Within this zone, the variability is sufficiently great, as has been pointed out by Dr. Crampton, Rotch and Smith, Pryor and others, to render grading on the basis of chronological basis alone inadequate.

Finally, this stage of development is reached by girls earlier than by boys, as has been indicated by almost every study of development having to do with this period of life.

While the close of later childhood is thus pretty clearly marked off by prominent developmental features, there is not at its beginning such a clear cut and astounding transition. Those factors which may be used as marks of development are much harder to distinguish, and therefore to correlate. There is available, however, a considerable body of facts that may assist us in the solution of one or two of the most important problems that have to do with this period, and in the statement of some other problems that need solution.

Among the important problems are these two: (1) Is there, at the age of five or six or seven years, evidence of a transition or nodality of development comparable in any manner to the transitional stage at puberty? (2) Is the advancement in the two sexes equal at this period of life, and if not, how do they differ? We shall take these up in order.

Evidences of Nodality

The School Age.—Turning to the first of the problems just indicated, it may be worth while, before taking up the discussion of actual physical characteristics, to point out that this period of the child's life has for centuries been recognized in a practical way as transitional, in that it represented the time for the beginning of formal education. The actual chronological age differed somewhat with different peoples, but for the most part formal training, as distinguished from home training was begun at the age of six or seven years.

Of China, Douglass wrote (31, p. 165): "School life commonly begins at the age of six, and the youthful learner is at once set to learn by heart easy text-books which give in short sentences the leading principles of Chinese polity." Monroe states that in the old Greek period the Spartan boy was taken after seven years of training under the direct care of the mother and put under charge of assistants to the paedamonus, being cared for from that time on in public barracks at public expense (56, p. 74). Similarly, Athenian boys began attendance at school at about the age of seven years (56, pp. 82-3). Plato, in his ideal Republic would have the boys taught music and gymnastics from the age of seven on (56, p. 135). Medieval and modern education have fallen into line. The legal age for school entrance in most states, and in most countries also, at the present time, falls within the sixth or seventh year. Thus in the educational practice of most nations it has been found experimentally that at about this time of

life the child has reached such a stage of development that he can undertake the tasks involved in education of a formal nature.

If, now, we turn attention to the more tangible evidences of the stage of development, we are led to several considerations. There are the matters of growth, both in height and weight, dentition, growth of various parts of the body, including skull, brain, larynx, eye, etc. Another group of facts also, related both to neurological structure and to psychology may be added. These have to do with the neuro-muscular control of the child. Finally, a few suggestions may be obtained from the field of pathology.

Height and Weight.—As regards growth in height and weight, it is generally agreed that the closing years of the later childhood period are years of retarded growth. This conclusion is based upon the results of numerous extended investigations. Conclusions regarding the earlier years of the period are much less definite, partly because of insufficient data, partly because of a difficulty in interpreting the meaning of the growth curves for these years.

Burk, who summarized the available statistics up to the time of his study, 1898, writes as follows (17, p. 257):

> "If now we turn to Table A of heights, taking, for example, the larger American studies of Bowditch, Peckham and Porter, we see that the rate of growth is somewhat rapid in the beginning, the sixth or seventh year, and decreases with fluctuations until about ten years in girls and twelve years in boys, when the prepubertal acceleration sets in. This general decrease is to be noticed in all the larger studies, though the year of the beginning of prepubertal increase varies a year or so. The same decrease in rate from six years up to the time of the prepubertal increase is to be observed similarly in the case of girls. Curves constructed from absolute annual increases show, as a rule, in this childhood period one or two pronounced fluctuations, but they do not occur with a regularity in all charts sufficient to be of assurance that their cause is certainly physiological and not merely statistical. Nevertheless, it will be observed that the curves are by no means regular. . . ."

Although pointing out thus clearly the irregularities in the curve for these early years, Burk goes on to conclude that, in the absence of determinative data, it is perhaps better to regard the period from about six years on as one of a general decrease in growth rate, with one or two minor fluctuations. The investigations of Combe, Landsperger and Carstadt, made upon a comparatively small number of children, but more upon an individual plan, are pointed to as justifying this view (17, p. 258).

Smedley, in the Chicago investigations, noticed something

of these irregularities in the early school years. Following his reference to the pubescent acceleration of growth, he writes (84, p. 32): "The charts seem to show that a similar but less well marked period of activity is present from the beginning of school life to the age of nine."

Englesperger and Ziegler (32, Bd. 1) found that of the children in the first year of school, those between the ages five years and nine months and six years were noticeably smaller, on the average, than those from six years and one month to seven years of age. The averages for these periods were:

	Boys	Girls
5 yr. 9 mo.—6 yr.=	109.65 cm.	106.25 cm.
6 yr. 1 mo.—7 yr.=	111.66 cm.	110.77 cm.

They found considerable differences in height at this period between half year, and even fourth year groups.

A tabulation comparing the weights of these periods showed that a smaller percentage of those under six years had gained than of those over six years of age. This was on the comparison of weights eight weeks apart at the beginning of school.

Stratz (86, p. 66), in Germany, on the basis of rather limited statistics, agrees with a former author, Bartel, in making the first four years a period of bodily "fullness," the years from five to seven, inclusive, a period of "stretching," or spurt of growth, and the years eight to ten a second period of bodily fullness, preceding a second spurt from the age of eleven to fifteen.

So far as available statistical material is concerned, growth in weight presents a condition similar to growth in height. Without giving the data these tabulations may be characterized briefly, and their indications may be stated. Most tabulations begin with the school age and continue from that time on, thus preventing comparisons with the years that precede. Usually, also, the number of data for the earliest school years are few in number. Again, statistics for weight present an added difficulty in interpretation because of the greater variability in this factor. So far as comparisons of absolute figures may be relied upon, there is only a continuous but variable increase in weight from year to year in the two sexes, up to the age of nine or ten, when a retardation occurs. Boys appear to be slightly superior, throughout the entire course.

There is slight suggestion of a spurt of growth in the beginning school years, but there is not sufficient evidence to establish the point. What is needed here is a collection of

more data, beginning with the lower years and continuing through the beginning school years. One cannot see in these studies of height and weight a definite proof of a characteristic of growth at this period. It is a fact, however, that from the larger investigations the results strongly suggest a slight acceleration. It is also to be remembered that most of the tabulations have paid attention to yearly age groups only. Much more accurate would be a comparison of age groups for fourth years or perhaps for months.

The rather indefinite studies of development, as indicated by increase in growth in height and weight, may be supplemented by some more definite facts with regard to individual organs or parts of the body that give more distinct evidence of a nodality at the school age.

Development of Teeth and Jaws.—The period with which we are here dealing is distinctly a transitional one as regards the development of the teeth and jaws. These present a number of phenomena, transitional as well as developmental in their nature, that group themselves about the years in which the change from first to second dentition occurs. Some of these are very evident, others less so, but altogether they make up such a group of developmental processes, so closely associated with each other, and also to other phases of physical and mental development that they deserve to be noted considerably in detail.

Aside from this, there are also other well grounded reasons for dwelling somewhat at length upon this topic. 1. Anatomically, the teeth and jaws are the most important structures in the facial part of the skull. Much of the remaining portion is of rather secondary nature, its purpose being to furnish place for attachment of muscles or to give proper bracing and support for these parts. 2. On the side of physiological functioning the teeth and jaws are extremely important. Upon them devolves a great part of the preparation of food in the process of digestion, not to mention the part they play in articulate speech. 3. Again, from the view point of hygiene, it may be said that columns of good, sound teeth, so located as to bring their chewing surfaces into proper occlusion, are requisites of good health. The absence of these conditions may lead to any of a number of allied disturbances, to which more detailed reference will be made later. 4. Finally, since they occupy so prominent a place anatomically, the form and general outline of the face are to a great extent dependent upon teeth and jaws. It therefore follows that from the view point of esthetics the proper formation and development of teeth and jaws may not be left unconsidered. Thus we may

say that from any of the four view points, esthetic, hygienic, functional or structural, development of teeth and jaws deserves the fullest consideration. We shall attempt to consider the topic from all four of these view points in the following paragraphs devoted to it.

While most concerned with the transitional phenomena, so much depends upon preceding and following developmental processes that a rapid review of the entire period of dentition may be of value in setting forth more clearly the characteristics of the transitional period. In this review, it is assumed that the reader's general knowledge of form, names, and composition of the teeth is sufficient to render detailed descriptions unnecessary. Since similar knowledge with regard to the jaws, on the other hand, seems to be less general, descriptions of the principal structures with which we shall need to deal will be included. For the sake of clearness, the facts with regard to development of the teeth will be presented first, then those with regard to development of the jaws. With these two groups of facts before us, we may next proceed to discuss their relationship and its significance, and arrive at some conclusions. With these hints as to method of procedure before us, we turn next to the presentation of the facts.

Although the eruption of the first or temporary teeth from the gums does not take place until some time after birth, the formation of their crowns begins very early in the developing embryonic jaw. Their calcification is already far advanced at the time of birth. The early formation and development of these is somewhat as follows: Above the gums, along the rudimentary jaw of the embryo, there is formed very early a ridge of epithelial cells. At each of the ten points at which a tooth crown is to be formed, a depression or invagination occurs in this ridge, pushing on downward into the jaw in a line, as it were, or tube, and expanding at the end into a bell-shaped structure,—the enamel organ. Gradually the enamel organ grows down over the top and sides of a small mound-like enlargement that rises up from the deeper tissue, —the dental germ. Again a little later the connection of the enamel organ with the epithelial ridge above is lost, enamel organ and dental germ together become isolated from the surrounding parts and enclosed in a " dental sac," and within this sac the two organs proceed to build up the parts of the tooth crown. Out of the soft cells that make up the enamel organ is formed the enamel; out of those of the tooth germ is formed the dentine or ivory of which the inner part of the tooth is composed, and within which, again, is the open cavity containing the pulp.

The transformation of these soft cells into the hard structures of the crown is accomplished by means of the deposition of lime salts within the cells themselves, and is usually spoken of as a process of calcination or calcification. The processes are not the same in both cases, however. While the cells of the enamel organ become changed into solid crystals, those of the dental germ receive the lime deposits only around the outside in such a way that the resulting structures are elongate tubes. The central, uncalcified portions remain as fine fibrils which are connected with the soft pulp of blood-vessels and nerves that fill the inner cavity of the tooth. The dentine tubes thus formed are of considerable length and extend outward radially from the pulp cavity to the enamel " roof " of the tooth.

The direction in which the calcification proceeds differs in the two organs. It will be remembered that the enamel organ folds over and encloses the dental germ. Now, the calcification begins at the contiguous surfaces of the two organs and proceeds in both directions. For the enamel cells, then, calcification proceeds from the inner surface toward the outer; for the dentine cells, it proceeds from the outer surface inward toward the pulp cavity.

Enamel and dentine differ also in another way. The enamel crystals receive no more nourishment after being once formed. The dentine cells, on the other hand, continue to receive some nourishment throughout the life of the tooth by means of the soft fibrils in the central tubular portions. (63. p. 31.)

As the development of a crown proceeds beneath the gums there is deposited around it a layer of bony substance, so that by the time it is completed it is almost enclosed in a bony case or crypt. The top of the crypt is open, though the aperture is not large enough for the crown to pass through without absorption of some of the tissue from its edges. This is what occurs at the time of eruption of the crown.

After the manner thus described there are formed ten tooth crowns in each of the jaws. Their calcification is not entirely completed by the time of birth, but it is completed within the first few months of life. Then they emerge from the gums to form the " temporary set " that functions during the early years of the child's life. Of these, the incisors and canines are small, as compared with the corresponding teeth that follow. The bicuspids, or milk molars, on the other hand, are larger than the permanent bicuspids that follow. In this way ample provision is made for the mastication of such

foods as the child is able to digest and assimilate during his early years.

Some weeks after birth the crowns of the temporary set are completed and begin to erupt from the gums. The first become visible at about the sixth to eighth month of life, usually, and at the age of about two and one-half to three years the child is equipped with a full set of twenty. Appearance is usually in groups, beginning with the central incisors and proceeding, in a general way, backward from these, with intervals of time elapsing between the several groups. Witzel reports the usual time for the eruption of these, as given by Thomas and Baume, to be as follows (98, p. —):

Central incisors	6- 8 mo.
Lateral incisors	6-12 mo.
Anterior bicuspids	12-16 mo.
Canines	15-20 mo.
Posterior bicuspids	20-30 mo.

The basis for this statement is not given, no mention being made of actual investigation. The periods given are those within which the eruption from the gums usually occurs. It is possible for the teeth to appear much later, however, and yet be normal. It is also possible for a few of the crowns to be already visible at birth and the teeth be normal, though this is very often the result of diseased conditions.

The process by which a tooth crown erupts is somewhat complex. The edges of the opening in the bony crypt must first be reabsorbed, making room for the crown to push through. The gums that form the covering are next absorbed. While this is going on and the crown gradually pushing upward, additions are made to the root from cells at the base of the crown, and, once the final position is attained, the root becomes fastened into place by the bony tissue built up around it. The root canal remains as a rather wide opening for some time, however, the dentine being built up gradually until the root is solid, except for the narrow canal through which the vessels and nerves are admitted to the pulp cavity.

The tissue built up around the teeth and within which their sockets are found is known as the alveolar border of the jaw or alveolar process. It is developed with the teeth and apparently for the specific purpose of holding them in position. Fuller description of it may be reserved until later. A description of the means by which the tooth roots are firmly fastened within it, however, is in place at this point. This can best be given in the words of Dr. Angle, taken from his paragraph on " Peridental Membrane " (1, p. 122).

"The peridental membrane is a strong, fibrous membrane forming a close, cushion-like investment of the roots of the teeth, and is the medium of attachment between the alveolar process and the cementum. It is composed largely of inelastic connective tissue, and is richly supplied with nutrient vessels, nerves, cells, and glands. Its function is three-fold:

"First, vital, for the formation of the alveolar process on one side and the cementum on the other.

"Second, sensory, through which the most delicate touch of the tooth is felt.

"Third, physical, holding the tooth in position in the alveolar socket, and resisting the movements of the teeth in the various directions. It also supports the soft tissues about the teeth."

Continuing, Dr. Angle enumerates the kinds of cells of which the peridental membrane is composed as, *1*, fibroblasts, for the formation of fibers of the membrane; *2*, osteoblasts, for the formation of the alveolar process; *3*, cementoblasts, for forming the cementum; *4*, osteoclasts, for disintegrating calcified tissue; and finally, *5*, glands, the function of which is as yet imperfectly understood (1, p. 123).

Malposition of temporary teeth is rare. When it does occur, it is easily corrected, under normal conditions, by means of the pressure from lips and tongue. But while this is true, abnormal conditions may as readily cause the teeth to be moved from their proper positions and thus bring about a malocclusion.

But the temporary crowns are not formed alone in the embryonic jaw. The beginnings of the permanent crowns are also present at a very early stage. Very early in the development of the enamel organ of each of the temporary teeth a second line or tube of epithelial cells pushes down by its lingual side. It appears as a branch of the tube which develops into the enamel organ of the temporary tooth. In structure, too, it is similar, and its development, later, after the manner described for the temporary tooth, results in the formation of the crown of the permanent tooth.

Aside from the ten corresponding to the crowns of the temporary set, there are also six other germs in each jaw, as the beginnings of the molars of the second set. The child at birth, then, has in each jaw the almost completed crowns of the ten temporary teeth and also the germs of the sixteen permanent teeth at various stages of development. The completion of the permanent crowns is of course later than that of the temporary, their time of most rapid growth, according to Pedley (62) being from birth to three or four years of age. Johnson places the critical period for their calcification at from birth to the age of five years, that of the first permanent molars having been begun even before the birth of the child (51).

The time of these processes is given more in detail by Witzel (98, p. 17):

"The calcification of the crowns of the incisive teeth begins between the first and second year and the calcification of the canine tooth in the third year. In the fifth year of age the tuberosities for the second molar tooth are developed and in the ninth those for the third. About the time of the ninth year no remarkable processes of calcification take place in the crowns, except in the wisdom tooth, but the roots are not everywhere fully developed. . . ."

The ages mentioned are of course only approximate, and vary within wide limits.

From this it follows that from birth to about five years of age is a critical period for all the permanent set, except the wisdom teeth. During this period the dental germs, many of which have begun development at the time of birth, attain their final form, make their most rapid growth and undergo a great part of the process of calcification. In this connection it should be emphasized that when once formed and completely calcified, these crowns are adult crowns, as large as they will ever be, and subject to neither growth nor repair, so far as the organism to which they belong is concerned. Completion of the crowns is accompanied by enlargement of the alveolar border and growth in some parts of the jaw, with considerable redistribution of the inner structures.

Thus far we have noted the principal features in the formation and calcification of the temporary crowns, marked the important changes involved in their eruption and in their fixation into position by means of developing root structures and alveoli, and have traced the important steps in the process by which the permanent crowns are formed, developed and calcified within the alveolar portions of the jaws. Each one of these is a developmental feature characteristic of the earlier years, and constitutes a step in the preparation for the coming of the permanent teeth. The time immediately preceding second dentition is therefore a remarkable one for the child, considered from the view point of his dentition. Within his jaws there are *1*, a full set of twenty functioning temporary teeth, *2*, the practically completed crowns of their twenty successors, many of which are larger, *3*, the completed crowns of the four first permanent molars and practically completed crowns of the four second molars, and *4*, the only partially developed germs of four wisdom teeth or third molars. This is the normal condition of the child's jaws at the age of five or six years. Transition to the second dentition usually begins very soon afterward.

In discussing the eruption of the permanent crowns we may

first give attention to the time of their appearance, and then turn to the description of the process by which it is brought about.

Time of appearance of the permanent teeth has been made the object of a number of investigations. Some of these are of no value for our purpose, since they do not differentiate the sexes. Of the three available that do, one is not extended, but the other two are sufficiently so to make their results valuable.

First let us turn to the statistics of Boas and Wissler. Their material was a series of plaster casts taken from the palates of 219 boys and 276 girls. They therefore contain data for the upper jaw only. The following Table A is their table numbered "XI C." giving results in percentages (11, p. 34):

TABLE A.

PERCENTAGE OF CHILDREN HAVING PERMANENT TEETH.

Age	Boys						Girls					
	In. Inc.	Out. Inc.	Can.	Bic.	1st Mol.	2nd Mol.	In. Inc.	Out. Inc.	Can.	Bic.	1st Mol.	2nd Mol.
6	30	4	....	....	65	....	38	9	6	15	83	2
7	40	6	3	3	83	....	79	28	2	41	92	....
8	81	26	....	19	100	....	84	48	9	45	93	6
9	97	67	....	30		7	100	59	9	45	100	2
10	100	63	33	66		3	94	82	14	73		8
11		95	61	100		9	96	96	73	83		20
12		100	85			38	100	100	86	100		32
13			91			68		88	88			68
14			100			66		90	90			90
15						75		100	100			100

Averages and variabilities were computed for the time of appearance of the several teeth and found to be as follows (12, p. 35):

	Boys	Girls
Inner incisors	7.5 ± 1.5 yr.	7.0 ± 1.6 yr.
Outer incisors	9.5 ± 2.1	8.9 ± 2.1
Bicuspids.	9.8 ± 1.6	9.0 ± 2.8
Canines	11.2 ± 1.4	11.3 ± 1.0
Second molars	13.2 ± 2.0	12.8 ± 1.6

TABLE B.

Age in Years	Sex	Number	Inner Incisors		Outer Incisors		Canines		First Premolars		Second Premolars		First Molars		Second Molars	
			Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
5.5– 6.	M	10	2	2	...	...	...	...	...	...	...	...	8	12	...	...
	F	6	...	...	...	...	...	...	...	1	...	...	...	4	...	...
6. – 6.5	M	42	...	13	...	...	...	...	...	...	...	...	26	50	...	...
	F	33	7	20	...	...	...	...	2	...	...	...	28	41	...	...
6.5– 7.	M	115	30	115	1	13	...	...	3	1	3	1	166	173	...	...
	F	140	50	147	4	33	...	1	3	3	2	...	211	242	...	...
7. – 7.5	M	97	44	145	3	26	...	...	1	...	...	...	179	182	...	...
	F	117	81	191	15	65	...	...	3	2	1	...	215	224	...	...
7.5– 8.	M	114	107	207	19	89	...	2	10	4	...	1	217	222	...	...
	F	119	174	224	47	116	1	2	15	3	3	...	233	233	...	...
8. – 8.5	M	101	157	194	55	125	...	5	21	3	2	3	193	194	...	...
	F	110	193	216	87	163	2	12	34	11	10	9	214	218	...	1
8.5– 9.	M	129	213	243	117	196	2	1	35	10	20	8	255	255	...	...
	F	117	217	229	145	189	9	17	62	28	17	15	233	232	...	...

9. – 9.5	M	124	228	243	167	220	1	17	72	32	21	15	**248**	**248**	...	...
	F	130	258	258	210	249	26	60	96	66	30	27	**260**	**260**	1	3
9.5–10.	M	134	262	266	239	259	9	27	111	57	48	34			1	6
	F	139	273	277	249	273	26	79	131	83	54	43			7	17
10. –10.5	M	115	**230**	229	207	227	18	34	107	70	59	44			4	8
	F	120	**240**	**240**	232	238	53	116	154	131	91	77			10	32
10.5–11.	M	112	**224**	**224**	209	222	35	68	136	86	92	51			14	36
	F	136	**272**	**272**	261	**272**	95	175	184	140	115	94			29	61
11. –11.5	M	119			227	**238**	70	137	140	127	109	73			26	62
	F	125			244	249	130	200	180	180	150	132			49	113
11.5–12.	M	116			227	**232**	83	149	181	144	133	91			46	74
	F	138			272	274	149	225	237	220	188	153			91	154
12. –12.5	M	128			253	**256**	151	110	222	210	189	151			127	161
	F	134			261	267	198	245	240	229	191	171			108	157
12.5–13.	M	97			193	**194**	132	165	181	160	150	133			113	145
	F	105			209	**210**	161	192	204	184	169	150			123	154
13. –13.5	M	59			**118**	**118**	94	106	110	98	104	95			91	105
	F	64			126	**128**	112	**128**	126	123	121	116			105	120

The investigation of Berten was much more extended. He collected data from some 3,345 children in Germany, of ages ranging from five and one-half to thirteen and one-half years. In the accompanying Table B are presented the numbers of teeth present for each half-year group within these ages. This table condenses the data found in Berten's tabulation (8, pp. 278-9). Boldface figures indicate groups where 100 per cent. were found present.

A report of an investigation much more extended than either of these appeared in recent years. Dr. Röse has tabulated the number of teeth found present in the several groups in case of 41,021 children in Germany, Sweden, Denmark, Holland, Belgium, Bohemia and Switzerland. His tabulation differentiates upper and lower teeth, also sex groups, and gives the averages and variabilities for the several tooth groups.

Table C is his "Table XIV," in which the results of the investigation are summarized (77, p. 564):

TABLE C.

ERUPTION TIME OF PERMANENT TEETH IN 41,021 SCHOOL CHILDREN FROM GERMANY, SWEDEN, DENMARK, HOLLAND, BELGIUM, BOHEMIA AND SWITZERLAND.

	Boys=21,139			Girls=19,882		
	Average eruption time		Eruption time varies between ages	Average eruption time		Eruption time varies between ages
	Yr.	Mo.		Yr.	Mo.	
UPPER JAW						
Incisor I...	7	8	5.5–11.5 Yr.	7	5 (−3 Mo.)	5.5–11. Yr.
Incisor II...	8	11	6. –(?) "	8	6 (−5 ")	6. –(?) "
Canine.....	12	2	7.5–15. "	11	7 (−7 ")	7. –15. "
Premolar I.	10	5	6.5–14. "	10	1 (−4 ")	6.5–14.5 "
Premolar II.	11	4	6.5–15. "	11	1 (−3 ")	7. –15. "
Molar I....	6	7	5. – 9.5 "	6	6 (−1 ")	5. –10. "
Molar II....	12	9	9. –15. "	12	5 (−4 ")	9. –15. "
LOWER JAW						
Incisor I...	6	10	5. –10. Yr.	6	7 (−3 Mo.)	5. –11. Yr.
Incisor II...	7	11	6. –12. "	7	7 (−4 ")	6. –12. "
Canine.....	11	2	7. –15. "	10	3 (−11 ")	7. –14. "
Premolar I.	11	3	7. –14.5 "	10	8 (−7 ")	7. –14.5 "
Premolar II.	12	0	7. –15. "	10	7 (−5 ")	7. –15. "
Molar I....	6	5	5. –10. "	6	3 (−2 ")	5. – 9. "
Molar II....	12	3	9. –15. "	11	9 (−6 ")	8. –15. "
Avg. of the total 14 eruptions.	9	10.0		9	5.4 (−4.6 Mo.)	

Careful study of these tabulations will show that they are in agreement as to the essential points regarding the time and the order of eruption of the permanent crowns. Each one confirms the prevalent view that transition to second dentition begins with the eruption of the first permanent molars. This is evident in the tabulation of Berten, and in the averages from the very extended investigation of Röse. Berten writes that in only three cases did he find the transition to the permanent teeth beginning before the appearance of any molars (8, p. 271).

Incidentally it should be noted that the time for the appearance of the first molars is in the seventh year. Berten's table indicates that practically all appear between the age of six years and seven and one-half, while Röse's averages all fall between the ages six years and three months and six years and seven months.

Again, the more extended investigations of Berten and Röse have furnished abundant evidence in confirmation of the view that the lower teeth appear, on the average, earlier than the upper, except, perhaps, in case of the canines and bicuspids. In all the investigations a considerable variation in the time of appearance for the several tooth groups is evident. From this it follows that dentition does not run a parallel course in all children. Variation in time of appearance is least in case of the first molars and grows progressively greater with each succeeding tooth group, up to the bicuspids and canines.

The order in which the permanent crowns appear is represented in these data. According to them it runs: first molars, inner incisors, outer incisors, first bicuspids, after which the order of the remaining groups is somewhat confused. Berten states (8, p. 274) that most often we find these groups appearing in such a way that the lower canine follows the first bicuspids, and is followed, in turn, by the upper second bicuspid; then the lower second bicuspid appears, and the upper canine brings up the rear.

Finally, before leaving this topic, the point of sex difference in time of eruption of the teeth should be pointed out. In each of the three tabulations it is clearly evident, beginning with the first molars, at the very beginning-time of second dentition. Röse's results show the girls to be two months earlier in eruption of lower first molars; one month ahead in eruption of upper first molars, on the average. The actual difference of time is not so evident in Berten's table because of the form in which it is presented, but comparison of the numbers of the teeth present show that the results would be

in agreement. Presented in the form of curves showing the percentages of teeth present in the various groups, Berten's data show very clearly that this is true.

The processes by which the eruption of the permanent teeth is accomplished deserve some further consideration. Evidently the temporary structures must first be disposed of. This is the first step in the eruption of the permanent set. It is accomplished by a sort of reverse process to that by which the temporary roots are builded down and fixed within the alveolar border. Beginning at the lower parts, the roots are again reabsorbed, along with the bony case of their sockets, even before the term of functioning of the teeth is completed. Radiographs showing partially reabsorbed roots present very much the same appearance as those showing partially developed ones. Apparently the reabsorption, or resorption, as it is often called, is incited by the pressure of the developing permanent crowns below. At any rate, in normal cases the process is sufficiently advanced by the time the permanent crowns are ready to appear to allow the temporary tooth to be readily removed with very slight disturbance and very little pain.

Evidently here are processes in which the different types of cells in the peridental membrane described above, especially the osteoclasts, play a very important part. Pedley and Harrison (63, p. 52) would credit the leucocytes with an important part in the resorption process also.

Aside from the resorption of the temporary roots there is also a process of resorption of the cancellated tissue that surrounds the deeply embedded crowns, allowing for their passage upward toward the surface. In case of the molars, this includes the absorption of part of the cortical bone along the borders of the jaws where there have been no preceding temporary teeth.

The growth process by which the crowns emerge, making additions to the roots while so doing, is not essentially different from that of the temporary ones already described. Building up of the roots seems to be a somewhat slower process in this case, and their final cementing into place more permanent. This latter is rather an osseous change and will be mentioned more in detail later, but it should be noted in this connection that the order is always first tooth position, then adjustment of foundation. This is true regardless of whether the position assumed is normal or abnormal. The bony foundation builds to the tooth, whatever may be the position it assumes.

Again, difference in size, especially of incisors and canines,

is greater in the upper than in the lower jaw, so that readjustment of the two columns of teeth to each other becomes necessary. This is a fact of considerable importance for the normal occlusion of the teeth of the permanent set. Whereas the upper and lower teeth of corresponding names fit end to end in the temporary set, in the permanent, the greater size of the teeth in the upper column cause a backward shift along the sides. The normal condition is therefore for each molar and bicuspid to articulate, not with a single antagonist in the other jaw, but with two teeth.

So much for the phenomena of dentition. The treatment is inadequate, but possibly sufficient facts have been presented in this brief review to indicate that the beginning of later childhood is without a doubt a transitional period as regards the teeth. Preceding this period time and material are both devoted to the task of providing temporary structures and preparing permanent crowns; with the eruption of the first molars at this period, however, is ushered in a series of remarkable changes, every one of which is a step in the direction of dental maturity. Dr. Port (65) stated the case nicely when he referred to this period of life as one at which, for the dentist, the child becomes adult. The significance of these phenomena becomes greater when they are associated with others closely allied to them, and, in a way, depending upon them. To some of these we shall next give attention.

Paralleling that of the teeth, there must occur a progressive development of the bony arches of the jaws that form their foundations. Structurally, both jaws are complex, and are in very close relationship to the other parts that make up the facial portion of the skull. Thus the upper jaw forms the principal bone of the face, taking part in the formation of the hard palate, the floor of the orbit and the floor and lateral wall of the nasal cavity (71a, p. 50). Cryer states (27, p. 31) that in a surgical operation removing a right or left maxilla, "the inferior turbinate, portions of the lachrymal, the palatal, the malar, and the ethmoid bones will probably be removed with it." The lower jaw, on the other hand, has the distinction of being the strongest and thickest bone of the face. It is made up of the arched portion known as the body, and the two ascending portions called the rami, each of which has a flat, pointed projection at its anterior edge for the attachment of muscles, and at the posterior edge a convex process which hinges with the forward portion of the temporal bone and allows for the movements of the jaw.

Leaving aside for the moment the details of structure, we

may generalize with regard to the arched portions of the two jaws by saying that in either case, the essential features are (1) a basal osseous arch composed of an outer shell of cortical bone filled in with spongy, cancellated tissue, and (2) an alveolar border consisting of two thin, hard, compact plates, an inner and an outer, fitting close to the roots of the teeth, between which is the looser cancellated portion surrounding the roots of the teeth, and within which the more compact, shell-like cases surrounding the roots are contained. The whole arrangement of the jaws, both with reference to each other and to the remaining portions of the face and skull, is such as to withstand the strain of muscular contractions in chewing, and at the same time protect against forces from without, such as blows, by diffusing them in a way to prevent their being transmitted to the brain case (27).

As already intimated in a previous paragraph, the development of the jaws begins very early in the embryo. According to Quain's Anatomy (71), the order for the beginning of calcification of the bones is : first, the clavicle; second, the inferior maxillary (mandible); and third, the superior maxillary (maxillae). The Text-Book of Cunningham places the beginning at about sixth or seventh week of foetal life (28, pp. 144-5). Witzel would seem to agree as to time, since he published a plate (98, plate 3), showing calcification of the mandible in a foetus of six weeks.

In case of either jaw, calcification begins in a number of centers which later unite. The final completion of this process does not occur in the mandible until some time after birth (usually during the course of the first year), when the two halves unite.

Extended and accurate investigations of the growth of the jaws from this time until the beginning of second dentition are very few. On a few points, however, authorities seem to be in agreement, so that we may characterize in a general way the principal developmental features of this period. Naturally we turn first to longitudinal growth. After the completion of the first year, or at least after the completion of first dentition, there is little or no growth in those portions of the arches containing the temporary teeth. If any occurs at all it is very small in amount. With the appearance of the teeth there is a lengthening of the ascending portions of the lower jaw, thus making room for the teeth and their alveolar borders. The relationship of this development to the order of the appearance of the teeth constitutes one of the nice adjustments of nature, as Pedley and

Harrison (63, p. 42) have pointed out. In general, the order of tooth appearance is from front to back. By this means time is gained for the growth in the length of these branches, while at the same time there is not left an "open bite" in the middle of the arch.

As regards internal structure, arrangement of the fine bony particles or trabeculae remains for the most part regular, though there are some changes having to do with strengthening the jaws and adjustment to the developing crowns of the permanent teeth (98).

The rapid growth of the jaws at the time of second dentition is a well known fact. It is evident in the changed proportions of both jaws and face, with the resulting change in facial expression, and is also inferred from the fact that the second set contains a greater number and, to all appearances, larger teeth.

Growth is largely dependent upon the development of the teeth, and is therefore not uniform in all parts of the jaws. A number of investigators have attempted to answer the question as to whether there is any longitudinal growth in those portions of the arches bearing the temporary or deciduous teeth at the time of second dentition. Zsigmondi (106) reports the results from a long series of these investigations, and in addition describes an investigation of his own, in which, by the use of plaster casts, he employed a new method, obtaining records of the same jaws at different stages of their development.

Difficulties of method are everywhere apparent, not the least of which is that the measurements give a record, not of the differences in the basic part of the jaw, but rather of those in the dental arch or the alveolar border only. Referring in part to the results reported by Zsigmondi, in part to the original articles themselves, and comparing carefully, it seems only safe to say that there is not conclusive evidence that any longitudinal growth occurs in that portion of the alveolar arch lying between the first permanent molars during the period of second dentition. Since this is true, there is likewise no evidence to show that longitudinal growth occurs in the basic portions.

That the dental arch in the upper jaw becomes larger is not disputed, but attention is called to the fact that here the teeth with their alveolar border slant outward, while in the lower jaw they slant rather inward, so that the question of longitudinal growth of the basic part of the jaw is still left unanswered. Besides, the question as to the presence or absence of growth is most often raised with reference to the

lower jaw, the result being that most investigations have had to do with it, and have secured data pointing more or less to conflicting conclusions. However, while conclusive proof is lacking, there is not general agreement that growth does not occur. More recently Cryer (27, p. 14), who bases his conclusion upon the study of the anatomical arrangement of the inner structure of the mandible, has declared in favor of growth. Angle also seems to hold this view (1, p. 91).

While growth in the "deciduous arch" is still questioned, on one other point authorities are agreed. While the permanent incisors and canines require a greater amount of space than their predecessors, the greater requirement is partially compensated for by a lesser space requirement on the part of the permanent bicuspids, which are smaller. The actual need for growth in these portions of the jaws is therefore much less than it would be were the permanent teeth uniformly larger than their predecessors. The compensation is much less nearly complete in the upper than in the lower jaw, thus giving a second partial explanation of the fact that the upper permanent dental arch is apparently larger, while the increase in the size of the lower is questioned.

Let us turn attention next to the posterior portions of the jaws. It should be noted first that authorities generally agree that growth of these portions is dependent upon the development and eruption of the molar crowns. In either jaw the growth must be sufficient to make room for the three molar teeth on each side. The development of these crowns seems to be the signal for growth of this portion of the jaws. This is especially noticeable in the lower jaw. "The cutting of the first molar tooth and the formation of the crown of the second cause in the following years of life a strong longitudinal growth of the maxillary body, . . ." writes Witzel (98, p. 59).

As in case of the anterior portions of the arches, there is much disagreement as to the exact process by which the increase is brought about. Some authorities, such as Cryer, hold that growth is general along the jaw and that each erupting crown pushes the ones anterior to it forward (27, p. 14). Others take the position that the growth is only at the extreme posterior portion, and that much of it is due to absorption and deposition of the bone substance. Humphry quotes Tomes (48, p. 3, footnote) to the effect that these processes are shown by the examination of the histological structures at time of growth. Humphry also tested the growth in the lower jaws of young pigs by piercing the ascending portions and tying wires about the anterior and posterior borders. Later, when the pigs were killed, the wires at the anterior

border were found to have either become loosened or dropped out, showing that resorption of bone had taken place, while the wires at the posterior borders were found in deeply indented notches formed from the progressive deposition of bone above and below them (48, p. 3 ff.).

Besides the horizontal growth in the arches of the jaws, adjustment to the greater space required between them to accommodate the larger permanent set is accomplished by means of a growth in the length of the ascending portions, or rami, of the mandible. With the longitudinal growth downward and backward the angle of the jaw becomes more acute, approaching a right angle, though this is apparently due in part also to the development of the teeth and alveolar border.

Finally there may be mentioned a group of changes of inner structure. Rearrangement of the teeth brings about a necessary redistribution of their neural and vascular supply. Increase of masticatory surface, accompanied by a growth in strength of the muscles used in mastication, causes a strengthening of the basic portions of the jaws; lastly, as a result of rearrangement of the lines along which the forces are exerted in mastication, as well as of growth, there occurs a new arrangement of the bony trabeculae within the jaws to adapt to the new conditions.

In addition to that of the jaws, some other developmental factors appear to be very closely related to dentition. Possibly most prominent among these is the growth of the face, due in part, of course, to the increasing size of the jaws. West found in his Worcester investigation (97) that there are pretty distinct periods in the development of the female face, the first division point being at about the seventh year. Transitions from one type to the one next following seemed to be rather abrupt. Röse found from head and face measurements of more than 45,000 children of different nationalities that the face lengthens much more rapidly during the time of change of teeth than it does in later years (75, p. 711). Facial index increased in length some three and one-half degrees between ages seven and thirteen (75, Table 5, p. 706).

Greater masticatory ability seems to be accompanied by an inner psychic change. Bell (7) found in his study of the psychology of foods that taste becomes "mentalized" at about the age of seven as it has never been before. He speaks of this as a stage of "teasing to taste." He found also a tendency to make every possible mixture at this period, and an increased interest in medicine, with a tendency to taste it.

Dr. Wright (100) finds that periods of enlargement of the

tonsils without inflammation coincide with the times when the groups of molars are erupting. He finds that after giving the tonsil prophylactic treatment, when necessary, and waiting for the tooth to erupt, the return of the enlarged tonsil to the normal will follow in a high percentage of cases. Disappearance of abnormal tonsilar conditions also follows the treatment of carious teeth in many cases.

He contends that tonsilar enlargement without infection is but an expression of the normal functioning of lymphoid tissues in that region, especially active at times of tooth eruption because of additional requirements in the way of caring for waste material which results from rapid bone resorption, etc. The second period when this condition is liable to be present coincides with that for the eruption of the first permanent molars, and therefore in a general way also with the period of life in which we are here especially interested.

One hesitates to leave this topic without dwelling for emphasis upon the importance of dentition for development at the beginning school age. Referring to the relationship of the teeth to nutrition, Crampton (26, p. 354) has spoken of tooth appearance as "the indication of successful growth and the earnest of further preparation for growth."

Again, importance of dentition stands out clearly when one takes into account the number of conditions by which its progress is affected. The great variation in time of appearance has been noted. There are many explanations for this. Early or late dentition have often been charged up to heredity, and facts regarding the first set, such as those presented by Holt (45, p. 28) and Rosenhaupt (79) would seem to indicate that there is reason for doing so. Röse has found that permanent teeth appear earlier among Swedish than among German children, thus showing the influence of race (77). He would also credit the chewing of coarser foods with some influence in this case. Again, in the same investigation, Röse found dentition earlier in children of the higher schools than in those of the Volkschule, and earlier in children of city than those of rural communities. This is explained as due to differences of nourishment, and to some extent to better racial selection also. The importance of nourishment while the crowns are developing, therefore during the first five or six years of life, is emphasized by many authorities. Bell (7), without giving his authority, states that it is reported southern children erupt their teeth earlier than northern. Finally, it is recognized that diseases influence dentition. Holt (45, p. 28) says syphilitic children are prone to early dentition, in which case rapid decay is likely

to follow. Rickets is usually credited with having a retarding influence. Röse tested this (77, p. 569) by comparison of children with normal teeth and those with hypoplasia, or deficiency of enamel. Among 10,020 children, he found a slightly later eruption time in the latter group. Latest dentition is seen in cretinism (45, p. 29).

The complexity of the problem is evident. Berten says (8, p. 267) that whoever has given only slight attention to the eruption of the teeth will have found that the time varies with race, climate, sex, constitution and disease, and in part to sports of nature.

Composition of the tooth crowns is apparently affected by many of the same influences, especially conditions of nourishment and disease. Lack of lime in food and water may cause poor dental structures, with deficient enamel, and therefore poor protection. Dr. Burnham (18, pp. 296-7) reports a number of investigations indicating that regions poor in lime show a high percentage of carious teeth. Pedley and Harrison (63, p. 47) emphasize the use of the teeth as beneficial, in that it increases blood supply and thus brings more nourishment. The disease of rickets apparently deprives the teeth of sufficient lime salts, being accompanied usually by hypoplasia, a condition in which the enamel is deficient.

Finally, we may cite the response of the organism to dental conditions, as evidence of the importance of the latter at the school age. Among others, Jessen (50, p. 1) quotes these conclusions from Röse's "*Zahnverderbniss und Zensur*" (*Deuts. Monats. f. Zahnheilk.*, 1904):

"*1.* The physical development of school children is greatly influenced by defective teeth. *2.* The poorer the physical development, the poorer also is the mental power ("Spannkraft") of the children. *3.* The poorer the teeth, the worse are, on the average, the grades of the children." In his article on the "Hygiene of the Teeth" Dr. Burnham writes (18, p, 298): "Of the various disorders frequently caused or aggravated by decaying teeth are not only enlarged glands of the neck, headache, neuralgia, earache, but indigestion, heart trouble, irritation of the nervous system, epilepsy, and perhaps chorea and other neuroses."

Preservation of a full set of sound temporary teeth and regulation of their positions when necessary are requisites for proper development of both teeth and jaws at time of second dentition. Premature extraction, too long retention, caries or malocclusion in case of the temporary set may be the cause of improper development of the jaws with impaction or with abnormalities in position of the permanent crowns.

Some experiments upon animals would seem to indicate the dependence of proper development in jaws and face upon a full set of functioning teeth. Walkhoff (92) cut one temporal muscle of a dog four weeks old, compelling him to chew only on the other side. Within three months a difference between the development of the two sides of the jaws could be detected, and at the end of a year the functioning side was much larger and stronger than the other. Dr. Baker (5) performed a similar experiment by grinding the teeth of young rabbits, preventing occlusion in one-half of the jaw. Not only the jaws, but the parts of the skull to which the muscles of mastication were attached showed the effects by their greater size and strength on the functioning side. The unused sides remained undeveloped. The prepared skulls showed a distinct asymmetry.

While emphasizing the point that the presence of all the teeth is essential, Dr. Angle has stated (1, p. 17) that, "in function and influence some are of greater importance than others, the most important of all being the first permanent molars." He explains further that this is true because, *1.* they are largest and firmest in their attachment, *2.* they have the most important location in the arches, *3.* their length determines the separation of jaws and length of bite, thus contributing to facial proportions, *4.* they are first in position and influence other tooth positions, and *5.* they are most constant in time of eruption and in the assumption of normal positions.

From all these facts, and especially in view of the close relationship of tooth development and nutrition, it must follow that dentition is a matter of prime importance in the early years. It would perhaps not be too much to say that, from among all the factors which may and should be considered for such a purpose, dentition is the best single indicator of the stage of physical development which a child has reached at any time during these early years, or, as some would state it, of physiological age.

Having dwelt somewhat at length upon this very important phase of development, we may bring together the principal points in this brief summary:

1. The development of the teeth and the parts closely related to them, particularly the jaws, give evidences of a transitional stage at about the time of the beginning school years. The loss of the temporary and the eruption of the second, permanent, more numerous, adult-sized set of teeth is begun at this time, producing a new, different method of

articulation. This is accompanied by rapid growth in certain portions of the jaws, with considerable rearrangement of the inner structures, resorption and deposition of bone substance, etc.

2. Normally, the transition is begun by the eruption of the first permanent molars, at about the seventh year, after which temporary tooth groups are replaced by the permament in the order; inner incisors, outer incisors, first bicuspids, with canines and second bicuspids following in variable order, and followed in turn by second molars. Wisdom teeth come much later.

3. The time of tooth appearance in different children shows considerable variability, beginning with the early years, clearly evident at the time the first molars erupt, and increasing rapidly with the progress of dentition thereafter.

4. Sex differences are apparent in the eruption time of the permanent teeth, those of the girls appearing earlier, on the average, than those of boys. Here also, the difference increases with the progress of dentition.

5. The vital significance of dentition as a factor in development is shown by its close relationship to nutrition, by its close relationship to the growth of other parts, such as jaws, face and skull; by the many influences, such as nutrition, race, sex, etc., by which it is influenced; and by the reaction of the organism to dental conditions as shown in physical development, mental power, and the like.

6. These things being true, it follows that the state of advancement reached in dentition is a good indication of the stage of progress which a child has reached in his total physical development. The transitional features described therefore take on an additional significance.

Growth of the Skull.—The period of life under consideration is apparently transitional as regards the growth of the skull. In Quain's Anatomy (70, p. 82) we read:

> "The skull grows rapidly during the first seven years of life. By that time, certain parts, including the circumference of the occipital foramen, the body of the sphenoid, the cribriform plate, and the petrous division of the temporal have attained their definitive size. The other regions also increase but little until the approach of puberty, when a second period of active growth begins, affecting especially the face and frontal portion of the cranium, with which is associated the expansion of the frontal and other air sinuses."

These facts become the more interesting when we recall that cessation of growth in these portions occurs at just about the same time as the beginning of more rapid growth

in parts of the face, as previously described, and as demonstrated by West (97) and by Röse (75).

Growth of the Brain.—Data with regard to the size of the normal brain at different stages of development are meagre. Aside from this, there are many difficulties which arise from unavoidable inaccuracies in methods of sectioning and preparing specimens, and also from the fact that individual variations are great. Averages of brain weights are therefore of doubtful value.

It is generally agreed that the early years are years of very rapid gain in brain weight. There are no data, however, to show beyond question that a distinct nodality occurs at the beginning of the later childhood period. Curves for brain weights at different ages can only be said to suggest that this is true. Pfister is reported to have found that the brain weight at the end of the sixth year is not infrequently equal to that of the adult (71, p. 342). This is also observable in the tabulation of brain weights collected by Vierordt (90, pp. 36-37). Donaldson, in his study of the brain was led to conclude, largely on the basis of the curve for brain weights collected by Vierordt, that, ". . . . By the seventh year the encephalon has reached approximately its full weight, the subsequent increase being comparatively small . . ." (30, p. 104). We may say, therefore, not that brain weights show, but rather that they suggest a transition from rapid gain in gross weight to a different mode of development from the school age onward. This suggestion is strengthened by the fact that the rapid growth of the skull ceases at about the same time. Again, psychological investigations seem to show for this period a rapid development of muscular control, and the like, suggesting development along the line of better inner organization rather than by means of mere addition of material.

Development of the Eye.—Embryonically, the eye develops as a specialized portion of the brain. It is therefore interesting to note that there is some indication of its having attained approximately adult size at the same time with the brain. Stratz (86, a) has noted the relatively large size of the eye as compared to the small face of the child in the early years, due in part, of course, to the rather late development of the facial portions. The statement of Merkel would indicate that there is a further possible explanation. Without giving data, he says (55, Vol. 1, p. 256): "In connection with the development of the whole eye-ball, it occurs that the horizontal breadth of the iris is already reached in the sixth year of

life." Parallel to this fact—provided data may be found to support it as fact,—there occurs at about the school entrance age a transition in power to use the eye and also to control its movements.

An important factor is the power to employ binocular vision. In this is involved the ability to "fuse" the slightly different images from the two eyes and interpret them as one object. This begins in the first few weeks of life, and according to Miss Sayer (82), is usually complete about the sixth to ninth year of life. In learning to overcome the difficulty, the child has a tendency to "squint," but overcomes it after learning to use the eyes properly. From defects of vision, however, he may develop a permanent "squint." This is easily cured by means of the amblioscope if taken before the age of six, but otherwise it develops, as does stammering, into a pathological condition that is very difficult to cure. The statement of Dr. Cornell (23, p. 243) with regard to this condition is in agreement with that of Miss Sayer. Again, while largely dependent upon central brain structure, there should be mentioned in this connection the lack of power to retain visual imagery in case of those persons who become blinded earlier than the fifth to seventh year (49).

Here, again, phenomena which apparently involve both visual organs and visual brain centers would seem to suggest strongly that the closing years of earlier childhood constitute a time of change, both with respect to structural development and functioning.

Larynx and Voice.—Vocal organs and vocal powers give evidence of a nodality of development at beginning of the later childhood period. Of the larynx Barth (6, p. 86) writes:

> "In the first two years of life the growth of the larynx is very slight. With the active use of speech in the following years the growth progresses more rapidly. It appears, however, to be limited more to the muscles that move the vocal cords. From the sixth to the fourteenth year of life the growth of the larynx is almost stationary again, or, if it is present, is very slightly noticeable, strikingly and disproportionately less noticeable than the growth of the remaining organs of the body."

Cunningham's Anatomy makes a similar statement (28, p. 972):

> "In the newly born child, the larynx, in comparison with the rest of the body, is somewhat large (———) and it continues to grow slowly and uniformly up to the sixth year of childhood. At this period there is a cessation of growth, which persists until puberty is reached, and then a stage of active growth supervenes."

Gutzmann's diagram of the averages for normal children of both sexes up to the age of fifteen (37, p. 51) indicates a rapid widening of the range of voice, beginning at the age of seven. Differentiation of the sexes is also shown at this time, the range for girls being wider than that for boys from this age onward. The diagram is as follows.

Neuro-muscular Control.—Differences in the power to control bodily organs indicate a transitional period at six or seven years. Speech development also gives such an indication. Apparently this period marks a stage of completion in speech coordinations, since infantile babble, if continued after this time, is usually considered pathological (22). Control of visual organs, as previously described, gives a similar indication. Unless corrected before this period, "squint" becomes permanent. Vocal power, on the other hand, as indicated by the range within which pure tones can be sung, shows a rapid increase from this time on (37). The two sexes also show a difference in breadth of range from this period onward, at least up to the pubescent years. Bryan's tests of precision in finger movements (14) showed that in both the "up" and "down" writing movements almost half the gain between the ages of six and sixteen was made between the ages of six and eight years. Halleck has stated, "The vital time for motor training is before the age of eight" (40, p. 835).

Pathological Conditions.—Some pathological conditions may be grouped together to show a relationship to this period of life. Stuttering, which differs somewhat from the infantile babble previously referred to, has been shown to be more prevalent at seven to eight years of age. Conradi (22) believes there is a causal connection between this and dentition. Jastrow (49) found among some 200 persons in institutions for the blind that those who had lost the power of sight previous to the age five to seven years did not retain visual imagery in their dreams in after years. Those blinded later than the age of seven, on the other hand, did retain visual imagery. Clouston, in his "Neuroses of Development" (21½), long ago observed that the age of seven or eight is a time when many neuropathic conditions are liable to

break out. In this connection again should be mentioned that "squint," also infantile babble are but natural when occurring previous to this age, while if lasting longer they seem to be so deeply grounded as to constitute pathological conditions.

These are by no means proofs, nor is the list complete, yet the suggestion is strong that after this period of life the physical organization is somewhat different from that which precedes.

Mental Development.—Adequate treatment of this topic would make this paper far too voluminous. We can touch it but briefly, stopping only for some general statements, chiefly concerning its relationship to our problem.

Early years have long been recognized as a time of sensory training, shorter attention span, shorter memory span, etc., but no sharp transition has been clearly shown. Mental tests are not yet sufficiently refined to grade accurately small steps of advancement. Individual variations are too great.

Though evidence to the contrary may be found, that there is a correlation of mental and physical development during school life has been indicated in a general way by such investigations as those of Porter (67), Smedley (84), Quirsfeld (72) and Crampton (26). Methods of grading mental advancement with reference to stage of physical development rather than chronological age at this period, however, have yet to be worked out. There is needed here much further investigation, on the individual plan, for the purpose of finding the degree of mental advancement that may be expected in a pupil of either sex who has reached a given stage in his or her physical development. The question arises as to whether such investigation might not show a characteristic of mental development corresponding to the transitions in the physical. Facts of brain growth, neuro-muscular control and the like suggest that this might be true.

Summary.—By way of summary we may generalize with regard to the preceding facts bearing on the question of nodality at the school entrance period as follows:

1. Disturbances of growth in height and weight have been noticed at this period but their nature is imperfectly understood.

2. Dentition shows distinctly a transition at this period, and because of close relationship to other phases of development suggests strongly that it is general in its nature.

3. Both skull and brain show a change in growth rate at about this time of life.

4. Growth of larynx and development of voice range indicate transition in these years.

5. The statements of some authorities with regard to growth of the eye and control of its movements suggest nodality in its development at this age.

6. Phenomena of muscular control, also facts regarding pathological conditions, give evidence of a change in physical organization after this period.

7. A clear-cut mental transition has not been shown, but tests have not related mental to physical stages of advancement. General correlations of mental and physical powers and facts regarding brain growth and muscular control suggest that tests relating these phases would indicate a transition here also.

On the basis of these facts it appears that the question regarding a transitional stage of development at the beginning of later childhood should be answered in the affirmative. The time at which these phenomena occur is of course only approximate, being based upon averages in most cases. The degree to which these changes are interdependent is also unknown. Whether they are all secondary to one basal, radical change, as for example dentition, or whether they represent a more general reorganization to which each is related cannot be stated. It seems probable that the latter is the case, although it is a problem that must be left open. It is certainly one that merits further investigation.

Comparative Development of the Sexes.

If, now, we give attention to the question of the comparative development of the two sexes at the school age, we are led to the consideration of a number of groups of data similar to those of the preceding section.

Occasional statements with regard to differences of the sexes at this early period of life have been made. Tyler (88, p. 139) that girls of six begin to show signs of the precocity which characterizes later development. Röse mentioned differences of sex at time of second dentition (77, p. 555). Stratz (86 a) thought sex differences in bodily form first become evident at the age of six, after which girls show more grace of curve, boys more of angularity and strength. For the most part, however, it has been taken for granted that the development of the two sexes is the same until some time after this period of life is passed.

In an article published at a time when this study was near completion, Dr. Boas (9) made some comparisons of develop-

ment, particularly in dentition and ossification of the skeleton, which showed a greater advancement on the part of girls at this period. As he has stated, however, the number of data was limited, and the study rather of a preliminary nature. While his conclusions are partially correct, it may still be said that no extended comparison of facts has been made to decide the matter of comparative advancement of the physical development in the sexes at the beginning school period of life. It is our purpose here to attempt such a comparison.

Height.—Comparison of absolute height at any given time in the early years does not show any cause for a differentiation of the sexes. The same is true of comparisons where added increments are reckoned as percentages of previously attained height. A question arises, however, as to whether this is an adequate method for getting at the actual attainment for a given age. At maturity the male is considerably larger than the female. Nor do they reach maturity at the same time. If, then, our final comparison is to be one of unequals, comparisons previous to that time should not be on a basis of absolute equality, else erroneous conclusions will result. What we should ask is not, "Does the height of the boy equal that of the girl at a given age?" Rather should the question be, "What are the percentages of final, adult height reached in the two cases at a given age?"

Comparison by such a method has been attempted. In a preliminary reckoning, taking Dr. Boas' averages for children of larger American cities, as given by Burk (17, Table H.), the average height of boys at 6.5 years is 69.88% of the average at 15.5 years, while of girls it is 70.35%.

Results thus computated, on the basis of data from a number of extended investigations, are given in Table D. Except in the last three cases, where the references are indicated, these are on the basis of the corrected averages given in Burk's "Table A" (17). These last three are not the corrected averages. Since adult heights could not be secured from the tables, the average at 17.5 years has been chosen as representing post-pubescent height.

Since girls are nearer adult height at the age of 17.5 years than boys of equal age, it is evident that they are at a disadvantage in these comparisons. Yet in every case the indication is that they have attained a greater percentage of their post-pubescent height at the age of 6.5 years than boys of the same age. Comparisons with averages of adult height would be more accurate, but it is plain that they would also show greater differences of the percentages, thus making the girls appear still more advanced, relatively.

TABLE D.

PERCENTAGE OF POST-PUBESCENT HEIGHT ATTAINED AT SCHOOL ENTRANCE PERIOD.

Investigator	Age	Compared to	Percentage for Boys	Girls
Bowditch.....(Boston).....	6.5 yrs.	17.5 yrs.	66.08	70.03
Porter.....(St. Louis)....	"	"	66.	67.60
Peckham.....(Milwaukee)..	"	"	66.10	69.60
.....(Oakland)....	"	"	58.20	70.80
West.....(Worcester)...	"	"	66.90	69.70
Gilbert.....(New Haven).	"	"	67.06	70.70
Gilbert.....(Iowa).....	"	"	65.98	69.14
Key.....(Sweden).....	"	"	69.40	70.60
Anth. Com'n..(England)....	"	"	66.46	68.60
Quetelet.....(Belgium)....	"	"	65.60	66.66
Pagliani.....(Turin).....	"	"	64.60	65.90
Hertel.....(Denmark)...	"	16.5 yrs.	68.11	70.40
[1] Smedley.....(Chicago).....	"	17.5 yrs.	66.99	70.29
[2] Lange.....(Germany)....	"	"	60.38	69.31
[3] Bobbitt.....(Phil. Is.)....	8	17	72.89	78.33

[1] See (84). [2] See (90, pp. 10-11). [3] See (12).

As a matter of interest, comparison of average heights of feeble-minded in nineteen institutions, as given by Goddard (35), was made, using ages six and twenty. Percentage of twenty-year height reached at the earlier age was, for males, 66.76, for females, 68.82.

Weight.—As in case of height, data for the average attainments of weight have not indicated any differences in the sexes preceding the pubescent period of growth. Both Porter (66) and Burk (17) noted a slight superiority of boys during the first few school years. Applying the method of comparisons just used in case of height, however, and using again the corrected averages from Burk's collection of data (17, Table E), we obtain the results presented in Table E.

While there is slight lack of uniformity in these results, in general it holds true that there is shown a superiority of girls in the amount of post-pubescent weight attained at the earlier age.

In case of both height and weight, therefore, the relative attainment of girls is shown to be slightly superior to that of boys at about the age of 6.5 years.

Skeletal Development.—Radiographic studies have shown that ossification of the skeleton proceeds more rapidly in girls than in boys during the early years. This is especially notice-

TABLE E.

PERCENTAGE OF POST-PUBESCENT WEIGHT ATTAINED AT SCHOOL ENTRANCE PERIOD.

Investigator	Age	Compared to	Percentage for	
			Boys	Girls
Bowditch.....(Boston).....	6.5 yrs.	17.5 yrs.	35.45	37.48
Porter.....(St. Louis)....	"	"	35.58	35.94
.....(Oakland)....	"	"	36.14	38.99
Peckham.....(Milwaukee)..	"	"	34.35	38.04
West.....(Worcester)...	"	"	34.64	38.00
Gilbert.....(New Haven).	"	"	36.00	38.96
Gilbert.....(Iowa).....	"	"	32.82	34.38
Key.....(Sweden).....	7.5 yrs.	"	*39.60*	*39.53*
Hertel.....(Denmark)...	6.5 yrs.	16.5 yrs.	*39.64*	*39.23*
Erismann.....(Moskow)....	"	"	34.83	42.37
Pagliani.....(Turin).....	"	17.5 yrs.	31.66	34.57
Anth. Com'n..(England)....	"	"	33.91	36.10
Misawa.....(Japan).....	"	"	34.61	37.14

able in the carpal bones of the wrists and the epiphyses of the joints. Dr. Rotch makes this statement, but gives few data (80, p. 416). Pryor's studies, however, give data by which this seems to be clearly indicated (69), though their number is limited. He quotes a conclusion from a previous paper by himself as follows (69, p. 3): "The bones of the female ossify in advance of the male. This is measured first by days, then months, then years."

Choosing the trapesoid bone of the wrist as an example, we may note that he finds its time for ossification to be between the fourth and fifth year in the female, between the fifth and sixth year in the male (69).

Dentition.—Differences in the time of eruption of the teeth should again be emphasized at this point. Greater rapidity in the eruption of the teeth of girls was shown in case of each of the investigations referred to, beginning with the first molars and continuing up to the time of appearance of canines and second molars. The difference is by no means as great, however, at the first molar stage as Boas found (9, p. 815) from his limited collection of data. Röse's averages show the difference in time of first molars to be as small as one to two months. It should be emphasized again that the difference in eruption time of the teeth grows progressively greater with advancement of dentition. By the time the second molars appear, the difference in time between the

two sexes approximates the difference in time between their attainment of pubescence.

Growth of the Brain.—The limited number of data renders comparisons of brain weights for the two sexes very difficult. Only general indications may be noted. Curves constructed on the basis of Vierordt's data (30, p. 105) seem to indicate an earlier attainment of adult brain weight in females. This can be said to be little more than an indication, however, on account of the difficulties of method formerly referred to and the great variability in brain weights.

Neuro-Muscular Development.—The probability indicated by brain weights is in correspondence with that indicated by facts of muscular control. Hancock found in his swaying tests that girls were more steady in the early years than boys (41). Automatograph tests showed better lateral control of the arm, and tremograph tests showed greater control of finger movements among girls also. Observations of less definite tests again showed the superiority of girls in control of movements.

Bryan's tapping tests seem to be alone in their showing of better control on the part of boys. He says (14, p. 173) that differences are slight, but that within the narrow limits indicated there is a slight superiority of boys over girls.

Strength tests were compared by Burk (17) by a method similar to the one we have used for height and weight. From the data of Porter, Roberts and Gilbert he found percentages indicating that boys had attained 1/5 their sixteen-year strength at the age of six years, 1/4 from six to eleven. Girls had gained a greater percentage at six, and from this on their acquirement was more rapid than that of boys.

Gesell noted that boys as a class show greater tendency toward uncoordinated writing as early as the first grade and up through the high school (33).

In this connection should be mentioned again that, beginning with the age of seven, the range within which pure tones can be sung is wider for girls than for boys.

Stuttering, which begins most often in the early years, has been found in a number of investigations to be more prevalent among boys (22, p. 361). Various ratios for the sexes have been reported. Conradi reports also that girls learn to talk earlier than boys (22, p. 363).

With the exception of the tapping tests, all the indications of power of control here enumerated show superiority in girls.

Summary.—On the basis of the data here presented it seems fair to conclude that the physical development of girls

is relatively more advanced than that of boys at the age of five or six or thereabouts. On the average they have then attained a greater percentage of their post-pubescent height, a greater percentage of their post-pubescent weight, their skeletal development is more advanced, and their dentition has progressed further. Aside from this there is a strong suggestion that a greater percentage of adult brain weight has been attained by them, and this is supported by the fact that most data available show a more advanced power of neuromuscular control. How great the difference in general physical development is a matter to be determined by further investigation.

Discussion, Pedagogical Suggestions, and Summary

So far, the aim has been to find solutions for our two main problems. For the first we may say that, while not proved, a great mass of data indicate a transition in physical development at the period of usual school entrance. Regarding the second we may say that greater advancement in the physical development of girls at this time is pretty clearly shown.

The solution or partial solution of these two problems suggests a number of others. If this is a transitional period, what is its fundamental nature? Is the transition general or due to a single factor, as dentition? That it is the former seems to be the case, but it is still an open problem. In case the transition is not of a general, fundamental nature, then a whole series of problems regarding the relationship of these several transitional phenomena arise. For example, is rapidity of dentition to be correlated with rapidity of skeletal ossification, as Holt (45) has stated is the case in infancy? Are disturbances of growth in height and weight noted at this period due to conditions of dentition or do they occur regardless of it?

The correlation of mental with physical development at this period is a problem which those working with mental tests cannot afford to neglect. Granted a degree of physical and mental correlation, and that this period is a transitional one for physical development, then the whole question of qualification for school entrance is thrown open anew. The problem is still further complicated by the fact of great variability shown in the developmental factors at this time.

In view of their close relationship to other phases of physical development, and in the absence of definite methods of grading, the question arises as to whether the time of appearance of the first molars could not be cited as a point before which school duties should not be imposed.

The differences of the sexes at this period also suggest some important problems. Recalling that the female reaches maturity some three years earlier than the male—or nearly so —and that she reaches the pubescent stage almost two years earlier, on the average, the fact that she has progressed further at the school entrance age is to be expected. The question arises here, however, as to how early the differentiation of the sexes actually begins. Since differences in the averages of absolute measurements are noticeable at birth, and in view of the popular opinion that the prenatal period is shorter for females than for males, one is tempted to raise the question as to whether differentiation does not actually begin before birth.

The problem of the amount of difference between the sexes comes up, and also the further one of working out a method sufficiently refined to measure them. The question as to what this difference signifies for the pedagogy of this period of life is an extremely important one.

The preceding facts and conclusions form the basis for some further conclusions and suggestions for the hygiene and pedagogy of the early years of childhood.

We have shown that boys and girls of equal age are not equally advanced physically at the school entrance period of life. We have presented a mass of evidence in support of the conclusion that this is a transitional period in the physical development, referring to the great individual variability, as indicated by dentition, skeletal development, etc. Associating these facts with the indications of a correlation between mental and physical development, the need of a physiological grading for entrance to school becomes strikingly evident. Granted a proper grading for entrance on this basis, the grief and the expense of " repeaters " up through the grades would be tremendously lessened. School entrance should be on the basis of the fitness of the individual, not on the basis merely of his chronological age.

Again, the rapid growth, the ease with which the delicate balance of the organism may be overthrown, the lasting detrimental results following the wrong " inclination of the twig," all suggest that the thing of supreme importance in these early years is rather health and development than formal school work. The paramount importance of habits of health is shown over and over again in case of the teeth. Lack of the habit of cleanliness of the teeth is followed by caries, loss of bicuspids or all important first molars, with probably ill-fitting permanent dentures, deformed facial features and injury to health. Habits of thumb-sucking, mouth-breathing,

and the like, may cause malocclusion and abnormal growth of jaws and related facial parts. Good permanent tooth crowns are largely dependent upon fresh air, exercise and good nourishment throughout the first five or six years of life. Attention to all these things should be first until after the organization of the childish body is more nearly complete.

The eyes are unfit for close visual work until after the transitional period.

Adenoids left uncared for in these early years are liable to cause disturbances of development. According to Yearsley (104) the time to have them removed is after six months and before six years of age.

Enlargements of the tonsils, with decreased power to resist invasions of micro-organisms, accompanies eruption of the first molars, in many cases (100, p. 13). Until after this time, no child should be confined to the school room where his chances of exposure to infectious disease germs are increased.

In view of all these things, this survey would be worth while, even though it did no other thing, could it portray in its true light the importance of all the years of earlier childhood for the normal, healthy physical development of the child.

From a different viewpoint another suggestion is in place. Could "types" be agreed upon for use in comparisons of stature, and like physical characteristics, similar to these used in anthropometry, much more accurate knowledge of development might be gained. Grouping of material according to types, combined with comparisons of relative advancement, such as we have used above, should lead to more satisfactory results in indicating stages of development.

Final Summary.

The main conclusions to which the facts presented in this thesis point are:

1. That there is a mass of evidence indicating a transition in the physical development of the child at the period of usual school entrance.

2. That there is evidence to show that girls are on the average more advanced in their physical development at this period.

3. That requirements for entrance to school based on stage of progress in physiological development, or physiological age, would be far superior to a requirement taking account of chronological age only.

4. That in the application of physical measurements for the purpose of finding degree of progress in physical development, a method indicating the percentage of adult size attained at a given age is superior to a method comparing absolute data directly.

5. That the hygiene and pedagogy of this period are of prime importance for the future development and welfare of the individual.

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THE MENTAL PROCESSES AS AFFECTED BY ALCOHOL

By Karl J. Karlson

Science in itself is one thing; its application is another. Sometimes these two are confused; sometimes they coincide. Science should always be pursued for its own sake and truth be its own reward. When the results obtained happen to conform to a prevailing theory it is well. It is a grave question whether a man can be a true scientist who looks for practical results only; for by so doing he is apt to interpret wrongly the results which his experiments yield him. Especially is this true if public opinion is for or against a given result. His disposition may then easily make him look a little askant and interpret his results accordingly even if he means to be honest and truthful. Therefore, great care must be taken in all experimentation, not only in the procedure itself but also in interpreting the results.

The problem which this paper attempts to treat is primarily a social-economic one. The question may be asked: Does the consumption of alcohol enable us to do our work more efficiently? If so, let us use it and be more efficient. If it does not, let us give it up and thereby save ourselves a great outlay of money and energy. The attempt will be made to answer this question from a scientific point of view by showing what has been done in this line by apparently competent investigators. Although the subject is limited to the effect of alcohol upon the mental processes, the paper will not be confined strictly to this. Its effect upon muscular activity is also interesting and will be included. But even here we have to do with nervous energy expended in the coördination of the muscular movements.

One of the first experimenters in this field to use the ergograph was Lombard (8) of Clark University. He made so few experiments, however, that his results can not be considered conclusive. His doses were also very small. But in voluntary action he found a slight increase in the amount of work done. The effect showed itself in a few minutes after the dose was taken and lasted in one case for an hour and a half. He concluded that the apparently favorable effect of the alcohol was due to some central action.

Schumberg (18) made three experiments, one with and two without general fatigue. He also used a very small dose of alcohol, only 10 gr., and drew the conclusion that in uncom-

plicated ergographic work alcohol had a beneficial influence, but that, in the presence of general fatigue produced by work with the ergostat, it had no influence.

A very interesting series of experiments with the ergograph was made by Schnyder (17). He used the index finger of the right hand, one of the best trained muscles in the human body. The finger raised and lowered a weight until exhaustion, when there was a rest of one minute, and then the process was repeated again, and so on twelve times. Each pull was recorded by a line on a kymograph, the height of the line showing the strength of the pull. The length of the lines was measured and the work computed by the kilogrammeter, i. e., the strength it took to raise one kilogram one meter. Now if the supposition that alcohol is a food, is true, it ought to assist in raising the weight. In order to settle this question, he made several experiments both with and without alcohol, as well as with and without food. All experiments were performed four hours after the morning meal, at 12 M., under similar conditions.

Before the first set of experiments nothing was taken. This served as a standard of muscular efficiency.

Before the second set of experiments 30 gr. of tropon consisting of 90% of animal and vegetable proteids was taken.

Fifteen minutes before the third set of experiments 15 gr. of alcohol was taken in 150 ccm. of Bordeaux wine.

Before the fourth set of experiments, some food was taken, so as to show its effect upon the muscular capacity.

Before the fifth set of experiments, 30 gr. of alcohol was taken with some food, so as to show its effect when taken as in ordinary life.

The results shown in kilogrammeters are as follows:

Period.	1st set.	2nd set.	3rd set.	4th set.	5th set.	
1.....	8.089	8.656	8.473	7.969	7.376	
2.....	3.732	3.911	4.227	4.418	3.872	
3.....	3.102	3.447	3.288	3.656	3.373	
4.....	3.031	3.244	3.120	3.440	3.182	
5.....	2.904	3.115	2.992	3.245	3.016	
6.....	2.838	3.033	2.821	3.215	3.136	
7.....	2.863	2.938	2.816	3.248	3.996	
8.....	2.903	3.054	2.709	3.223	3.004	
9.....	2.875	3.108	2.674	3.233	3.076	
10.....	2.885	3.097	2.725	3.254	3.929	
11.....	2.939	3.106	2.745	3.322	3.993	
12.....	2.843	2.913	2.732	3.282	3.922	Loss in the last two sets:
	41.004	43.622	41.322	45.501	41.869	8.0%
First five periods.....	20.856	22.373	22.100	22.724	20.056	8.4%
Last seven periods.....	20.146	21.249	19.222	22.777	21.056	7.6%

From this we find that in the third set, with alcohol, there is not such a sudden dropping off as in the first two. The effect is somewhat similar to that in the fourth set, where food alone was taken. But this increase turns soon to a general decrease. The stimulating effect is soon lost and a paralysing effect takes its place. When the alcohol is taken with food, there is a detrimental effect from the beginning, which suggests that the body will not use alcohol as long as it has something else to absorb. Thus Schnyder concludes that alcohol affects the working capacity of every muscle in the body, but that it depends upon when and how it is taken as well as upon the quantities whether it shall have any really injurious effect or not. This conclusion seems rather erroneous, for it appears from the results to have an injurious effect when small quantities are taken too. He does not, however, lay any stress upon the time it takes for alcohol to show its real effects.

This point was clearly brought out by Hellsten (3), who made three sets of experiments with an ergograph which employed many more muscles than the one ordinarily used in these experiments. Each series consisted of five normal and five alcohol days, and the time devoted to each experiment was forty-five minutes. In the first series, in which he administered a very small dose of alcohol, the effect was so slight that it might have been due to chance variations. In the second series he made many more observations and gave doses of 80% alcohol thirty minutes before the work was begun. The effect of this is best shown by giving the total amount of work done during the normal and the alcohol days expressed in kilogrammeters. On the former this was 5,967 and on the latter 5,111, making a difference of .856 kilogrammeters.

In the third series of experiments, he used the same amount of alcohol as in the second but taken at different times—immediately, thirty minutes, one hour, and two hours, before the experiment was begun. In all the experiments alcohol diminished the power of productivity. When taken two hours before the experiment the decrease amounted to 11%, and when taken one hour before, the decrease was 17%. When taken immediately or shortly before the experiment, there was an initial increase, which came to an end the more quickly the larger the dose of alcohol was.

Thus Hellsten found a stimulating effect immediately after alcohol was taken, but after one hour a considerable loss in efficiency, depending of course upon the quantity of alcohol taken.

So far the taste of alcohol seems to have escaped any par-

ticular notice by most experimenters, and still the pungent flavor of alcohol as it is usually taken is particularly adapted to produce effects both mental and physical which may be reflected in the kind and amount of work done. The stimulating action may be very much enhanced by this flavor, which may produce an effect before the real effect of alcohol has had time to make itself felt. Rivers (14) attempted to ascertain what effect alcohol had when the taste was eliminated. For this reason a control solution was prepared which tasted as nearly as possible like alcohol. Then two mixtures of alcohol were made, one containing twice as much alcohol as the other, this merely to assist in the disguise. Four series of experiments were made upon the observer W, In each series there were three sets of six ergograms, each made with an interval between the sets of half an hour. The rhythm was two seconds and the interval between the ergograms two minutes. The weight was 4.5 kg. and the drug or the control solution was taken in the first series of experiments ten minutes before the beginning of the second set of ergograms; in the second, between the first and the second ergograms of the first set; in the third, a larger dose of 10-20 gr. of alcohol was used in the same fashion as before, except that the intervals on half of the days were to be occupied with multiplication and on the other half with typewriting. In the fourth series of experiments the dose was taken also between the first and second ergograms of the first set. The whole experiment lasted twenty days, on six of which no dose was taken, on five the control solution, and on the remaining nine days a dose of alcohol of either 20 or 40 gr.

The result of this very elaborate and painstaking study shows that in the first experiment there is a slight variation from the normal, but this variation is also found in the control mixture and Rivers concludes that it is due to chance. In the second experiment there is an increase in the amount of work done during the alcohol days, greater on those with a larger dose than on the other, but in this dose the control failed to work. This is at any rate suggestive. In the third experiment the small dose of 10 gr. had no particular effect while 20 gr. showed an increase in the ergograms of the second and third sets. In the fourth experiment there is a slight effect in the third set begun an hour and a half after the drug was taken. This effect is also constant, wherefore Rivers concludes that we may possibly have to do with real drug effect here. But with a small dose there seems to be no effect unless the observer knows he has taken alcohol.

In another series of experiments which Rivers undertook

with larger doses of alcohol, 40 gr., there was a pronounced increase in the complete contractions and a smaller increase in the incomplete contractions. There was also great irregularity on different days; on some it was great, on others it was hardly noticeable. The immediate effect was slight, if any, but after it had once become noticeable it lasted fully three hours after the dose was taken. To determine therefore the duration of the effect an experiment was undertaken that covered a period of fifteen days with nine experiments a day. There was half an hour's interval between the first three experiments, while the intervals between the others lasted one hour. The curves show great irregularity, but the average increase in the amount of work done is very little. The increase was also immediate and lasted almost throughout the day.

We will now take up the experiments in which the mental processes are more directly involved. The pioneer work in Kraepelin's laboratory may well be illustrated in detail.

Aschaffenburg (1) was present at a meeting in Heidelberg where the assertion was made that even a small per cent of alcohol made work more difficult. He decided to test this assertion in the laboratory. Four typesetters offered themselves as observers. These were especially adapted for the purpose because their work could easily be measured both in quantity and quality. The external conditions were made as nearly as possible like the ordinary conditions under which they performed their work, and the experiments were made in their own rooms.

The observers were not total abstainers, but drank a glass of beer occasionally. During the experiment, however, they abstained from all liquor, as well as one day previous to the experiments. Their skill was as far as could be determined the same. The type was set from printed material, in order to eliminate manuscript reading, and a medium kind of type was used. The experiments were made on four consecutive days, Monday, Tuesday, Wednesday and Thursday, in the afternoon, and lasted for one hour and fifteen minutes. The first and the third days were normal and the second and fourth alcohol days. The only difference from their daily work was the sound of a bell every five minutes, when the letter should be placed on head. He supervised the experiments himslf, and the results were withheld from the observers until the experiments were completed.

The result of practice was also taken into consideration. It was found that there was a considerable increase in letters set every fifteen minutes as the experiments proceeded, varying

of course in the different individuals. This led to a differentiation between what was expected and what was really done. The effect of fatigue was also taken into consideration. It would be unnatural to suppose that the increase on account of practice should in the long run counterbalance the effect of fatigue. The dropping off toward the close of the experiment on the normal days is therefore taken as a result of fatigue.

Each experiment was divided into five fifteen minute periods and the alcohol was taken on the second and fourth days, Tuesday and Thursday, after the first fifteen minutes' period. The amount taken was 200 gr. of good wine containing 18% of alcohol, thus not a very large amount. The results show that in the normal experiments the number of letters set in the second fifteen minutes was larger than expected, but afterwards the rôle changed and more was expected than was really done. In the alcohol experiments the work of the first fifteen minutes after the alcohol was taken was smaller than in the preceding fifteen minutes. On the first alcohol day the decrease is progressive; on the second it is greater than in the greatest fatigue of the normal experiment and reaches its maximum in the third period.

The following table will show the loss from fatigue and alcohol from what was expected on the various days as well as the increase by practice:

Observer	Monday Normal	Tuesday Alcohol	Wedn'sday Normal	Thursday Alcohol	Increase by Practice	Decrease by Fatigue & Alcohol
Str.	2.1%	13.4%	5.8%	18.4%	8.2%	31.5%
L.	3.1%	7.4%	11.5%	16.3%	8.3%	30.0%
H.	8.2%	10.6%	6.4%	14.9%	4.6%	35.5%
K. O. G....	4.1%	14.2%	10.7%	18.9%	5.5%	42.4%

It is rather difficult to find the exact percentage of the effect of fatigue on the alcohol days, since we have to do here with the effect of alcohol too. But since Str. showed a decrease on the first day of 2.1%, and on the third day of 5.8% when no alcohol was taken, we may assume this percentage to hold throughout on the alcohol days too. If this be the case we should have twice 7.9%, or a total of 15.8%, to be deducted from the total of all four days, leaving in this case 15.7% decrease on account of alcohol. In this observer the effect of fatigue would thus be 0.1% greater than the effect of alcohol, but in all the other cases the effect of alcohol would be greater as is seen on the table. In all cases but one, L on Wednesday, the decrease is by far the greatest on the alcohol days. In the case of Str. the decrease on the first day is only 2.1%, but on the last, alcohol day, 18.4%. We have here

undoubtedly to do with the lasting effect of alcohol, too, so that the effect of one day was not entirely gone before it was reinforced by the alcohol on the next alcohol day.

It may be worth while to give the results of the experiments in "ems" set, also; for that will show the effect of alcohol even more plainly:

Observers	Monday	Tuesday	Wednesday	Thursday	Losses Tuesday & Thursday	
Str.	2339	2212	2560	2353	9.7%	11.9%
L.	2405	2449	2487	2492	0.0%	1.4%
H.	2241	2265	2458	2314	3.6%	9.9%
K. O. G.....	1528	1449	1608	1495	7.6%	9.3%

As is seen in this table, there are five cases where the men set less "ems" on T. and Th. than on M. and W., although they had the advantage of practice, and in the other cases the increase is very slight. Although the losses vary, as might be expected, in the different individuals, there is loss nevertheless from the previous day in all cases except three, L. on T. and Th. and H. on T., and sometimes very heavy. The increase from practice does not counterbalance this effect, and this increase is considerable. If we, for instance, take the increase of Str. from M. to W. as an increase in ability, we have 221 "ems" to be attributed to that, which would make 110 "ems" per day. In this case he should have set 2449 "ems" on T. and 2670 on Th., but instead he set only 2212 and 2353 on those days respectively, a very considerable loss.

The fact that the losses are heavier on Th. than on T. seems to show that the effect of the previous alcohol day has not yet disappeared when the new effect begins. The same was seen in the former table.

Aschaffenburg did not find that the quantity of alcohol he gave his observers had any effect upon the quality of the work done. No more mistakes were made in the alcohol experiments than in the normal, but he found that more mistakes were made on Monday than on any other day owing, as he assumed, to the falling off in practice during Sunday.

Thus he concludes that certain quantities of alcohol, 36-40 gr., decrease the productivity. Only once in eight experiments was this decrease absent. It averages 15.2% of the product which could have been expected without fatigue and without loss of practice. But the fatigue alone showed an average loss of 6.5% of the expected product. This leaves 8.7% to the credit of alcohol.

Kürz and Kraepelin (7) wished to find out what effect the quantity of alcohol contained in two liter beer, usually 80 gr., had upon the mental ability if taken regularly day by

day. Hence they started an experiment which lasted twenty-seven days. No alcohol was taken during the first five days, but in the evening of the fifth and on the following twelve this dose was taken just before going to bed. On the twenty-third and twenty-fourth days the same amount was taken as before. Unfortunately they did not have very many observers and were consequently not able to compare the results to any great extent. The experiment was performed at nine o'clock in the morning and lasted for two hours. The first half hour was devoted to adding single place numbers, the next half hour to memorizing twelve place numbers. In both these experiments the results were registered every five minutes. Then two periods of five minutes each were taken during which free associations to a given word were written down. And finally 308 monosyllabic words and 381 nonsense syllables were read off from a revolving drum. Thus the experiment took in: 1, Ability to comprehend; 2, Habitual association; 3, Free association; and 4, Ability to notice.

It was of importance to know the condition of the observer when not under the influence of alcohol, hence the first period; then to know the permanence of the changes called forth by alcohol, if any, and what effect a new beginning of alcohol had, after a time without it. The results were as follows:

1. In the experiment in adding there was a steady increase during the first eight days, three of which were alcohol days, but after the eighth day there was a small decrease, and on the fourteenth and sixteenth there was a good increase, which was followed by a decrease again, so that the result was not better on the eighteenth day than on the fifth, although the observer had had the benefit of practice all the time. Consequently the practice of thirteen days was lost.

2. The effect of the twelve alcohol days was not completely overcome for five non-alcohol days, although the work done on these was greater and more regular than on the preceding alcohol days.

3. After a longer period of alcohol, a keen sensitivity to the same remained, even after a period of abstinence of five days, which is seen in the rapidly sinking curve when alcohol is resumed for two days, the twenty-third and twenty-fourth.

In the experiment on the learning process Kürz and Kraepelin found that approximately the same changes took place as in adding, except that the irregularity and the falling off in the product was somewhat greater. In addition the estimated loss was 25% while in memorizing it was 40%.

In the association experiment the number of associations made was continually decreasing until about 31% were lost.

The quality of the associations was not perceptibly influenced. Sensory images were not, however, so prominent.

In reading from the revolving drum the number of words and syllables omitted grew larger as the alcohol days went on, but the qualitative changes were not here either very great. The increase of fatigue was also very marked in all the experiments, but especially in reading.

Thus we find: 1, Slower addition. 2, A decrease in the ability to memorize and a conscious struggle between slowness and speed. 3, More difficult association. 4, More difficult comprehension.

It is to be regretted that these investigators did not have a larger amount of observers. To draw conclusions from one or two is dangerous. They might have reached the limit of their ability on the fourteenth day; for the curve never again reaches the same height until the very last day, which may very well be the result of an end spurt so often seen in experiments. Or perhaps the fluctuation may be due to the wave-like appearance of the learning process. The person who served as a control performed the work under normal conditions, and his curve shows a steady rise almost similar to the alcohol curve during the first eight days, after which it keeps on rising, while the alcohol curve declines.

Kraepelin made another experiment, in which he was one of the observers, on the influence of alcohol and other drugs upon the mental processes in reading, adding, and memorizing numbers. The reading was done in a low but distinct tone; and each five minutes the amount read was marked off and used as a standard. In adding, single place numbers were added as fast as possible; but only one number was shown to the observer at a time. When 100 was reached the 100 was dropped and what was left added until another 100 was reached, etc. Every five minutes at the stroke of a metronome the amount added was marked off with a pencil and used in computing the results. In memorizing, the Ebbinghaus method was followed and twelve-place numbers used. Each group was repeated until the observer could repeat it without mistake. When the observer made a mistake the whole group was repeated again. Each repetition was marked off with a horizontal line in the margin, and each five minutes with a vertical line.

The experiments were performed between 8-9 o'clock in the evening. The amount of alcohol taken was 30 gr. in some, and 20 gr. in other experiments. Each experiment lasted fifteen minutes with five minute intervals. A series of normal experiments was made to serve as a standard. There were

in all seven observers. The normal experiment was performed before Christmas, the first alcohol experiment the seventh of March with 30 gr. and the other alcohol experiment the tenth of December with 20 gr.

In adding Kraepelin found that in the first fifteen minutes after the alcohol was taken there was a decrease in the numbers added in each five minute period. The great personal difference is very striking. One of the observers could add twice as many numbers as another. It is moreover clear that lack of practice for the long interval between the experiments made the standard worth very little. The influence of larger and smaller doses is very different in different individuals. A smaller dose had a greater effect upon one of the observers than a larger, but in general the larger dose showed its effect sooner, was greater, and lasted longer.

Kraepelin reports a subjective feeling of ease in these experiments and this is corroborated by other observers. He came to the conclusion that the different degrees of sensitivity manifest in different persons play a great rôle in the effect of alcohol. Sensitive persons suffer more immediate difficulty from a relatively small dose than do more stable persons, in whom the same dose and even a larger may give an initial increase before the falling off begins. If we compare the mean variation we find that the fluctuation is very great; and it is greater in persons who learn faster than in those who learn slower.

The repetitions necessary for learning the numbers varied considerably in the different individuals, from 17 to 68, and in all but two an increase of 5.4% in the repetitions was necessary during the course of the experiments. The larger dose does not seem to have had a very much greater effect upon the learning process. He. with 20 gr. needed 17 repetitions in the first experiment and 33 in the eight, while with 30 gr. 28 repetitions were necessary in the first and 32 in the eighth experiment. K. needed in the first experiment with 20 gr. 43 repetitions and with 30 gr. 47 repetitions, while in the eight with 20 gr. he needed 47, and with 30 gr. 53 repetitions. Thus with a dose 33% larger the increase in repetitions was only 2%.

In reading Kraepelin found a constant decrease of syllables read during the experiment under the influence of 30 gr. of alcohol, except in two cases where there was an increase, in one case from 2166-120 to 2423-38 and in the other from 2335-34 to 2498-19. In all but one case there was an increase at the beginning of the alcohol experiments over the normal. In three cases there was a decrease of syllables read even in

the normal experiment, in one case from 2296 to 2037, in the second from 2231 to 2059, and in the third from 2182 to 2141. Thus in four normal and three alcohol experiments there was an increase in syllables read, while in three normal and five alcohol experiments there was a decrease.

Kraepelin concludes that alcohol makes the work more irregular and that the effect is greatest about half an hour after the dose is taken. This effect may, however, be counterbalanced and covered over by the influence of practice. The greater this is, the less influence has alcohol. This is seen most plainly in reading, but is noticeable also in addition especially during the first fifteen minutes. The initial uplift in memorizing and reading had no influence upon the mean variation.

The after-effect of alcohol upon the nervous system was found to be considerable both by Kürz, Kraepelin, Fürer, and Rüdin. Fürer tested himself in a series of experiments with 80 gr. of alcohol, taken in one case at night and in another at noon, in adding, memorizing numbers, and association. He found that not only in the evening after taking alcohol was there a considerable decrease in the results obtained but also the next morning. Rüdin (15) found that this after-effect will last for twenty-four hours and therefore influence any experiment made before the expiration of this time as well as reinforce the alcohol taken before this time has elapsed. In this way, he says, is the chronic effect of alcohol brought about. Its effects are cumulative.

In his experiment on the duration of the effect of alcohol upon the mental processes, Rüdin had three observers for eight days, and one for eleven. The first three were experimented upon for one hour and ten minutes, morning, afternoon, and evening in the following way: 9:10-20 association, 5 minutes pause; 9:25-55 addition, 5 minutes pause; 10:00-30 memorizing. In the afternoon the experiment began at 2:30 and in the evening at 9 and proceeded in the same way as in the morning.

The fourth observer reacted also to complex stimuli so that his experiment lasted a little longer.

The quantity of alcohol taken corresponded to one-half liter of Greek wine with 18 to 20% alcohol, or two and one-half liters of beer, in all about 90 to 100 gr. of alcohol. It was taken half an hour before the experiment began, but in one observer only on the eighth day.

Rüdin found that alcohol had a detrimental effect both upon adding and committing to memory. Only in one observer was this effect not so marked. When the experiment was

repeated, the loss was twice as great as in the first. In one observer alcohol increased the repetitions necessary for retention but decreased the number in committing to memory. In another it seemed to have the same effect upon both processes. In two observers it decreased the number of repetitions but left their value in learning unchanged. The vocal movements were more difficult in two of the observers who happened to be motor minded but accelerated in the other two who were more sensory minded. The duration of the choice reactions was very much shortened immediately after taking the alcohol in two of the experiments. In one it was lengthened perhaps because in the beginning of the experiment the sensory part of the reaction was still noticeable and injury to it must necessarily lead to an increase in the time taken for the choice; but on the other hand under the influence of alcohol upon the motor discharge, especially short reactions took place. In two experiments there was a decrease perhaps because there was a gradual change of the reactions into motor, taking place toward the end of the experiment, and the disturbing effect of alcohol had less influence upon the comprehension of number than upon the acceleration of movement. Corresponding to the shortening of the time in choice reactions the numbers of errors increased from 1-2% in the normal to 4% after the first and 5% after the second dose of alcohol. The numbers of associations decreased in two observers but increased in two. This contradiction is apparently due to the different types which the individuals belong to, because alcohol seems to favor motor minded persons more than anybody else.

The after-effect lasted in two observers for forty-eight hours but was wholly lacking in adding and memorizing in one observer. The fourth showed some after-effect after twelve hours in adding but none in memorizing and association. Otherwise disturbances were seen all the way from twelve to forty-eight hours depending upon the kind and complexity of the work.

In another experiment on three students Rüdin (16) attempted to find out what effect alcohol had upon the ability to comprehend and upon the ability to retain. The observers read from a revolving drum which exposed, one at a time, 308 monosyllabic words and 331 nonsense syllables. The experiment was performed four times a day at 8, 12, 4, 8 o'clock for five days. On the third day a dose of 100 gr. alcohol was given the observer two minutes before the experiment began. It took seven minutes for the drum to revolve and a pause of ten minutes, sometimes twelve, was taken

between the experiments. Immediately afterwards thirty cards with nine letters on each were exposed for 16.7 seconds. Ten of these cards were to be reproduced immediately from memory, ten after 15 seconds, and the last ten after 30 seconds.

Rüdin found a marked disturbance in all observers, but the result due to practice was plain throughout. Comprehension suffered a gradual decrease until it reached the minimum at about eight hours after the dose was taken. The onset was from six to nineteen minutes after the dose was taken. The reading of nonsense syllables was more disturbed than the reading of words. The reading of cards was little affected in the first series, but in the second there was quite a disturbance, which became even more marked in the third series. The influence of alcohol was stronger and lasted longer in a more difficult task than in one less so.

The difference between the individuals as to the onset and disappearance of the effect of the alcohol was very marked. In one case it came on slowly and lasted long, and in another it came on suddenly and disappeared rather suddenly. In one observer it affected one kind of work more noticeably, in another another kind of work.

Mayer (9) undertook to find out what influence alcohol had upon writing. He served as an observer himself. Kraepelin and Rüdin had found that comprehension and sense impressions were made more difficult and that the acts of will were not made more easy. The ergograph experiments had shown that the energy used up under the influence of alcohol was not very much greater after all. It was to find out and solve, if possible, this seeming inconsistency that Mayer undertook his experiments. The first of these lasted for seven days, four of which were alcohol days and three normal; the second included two alcohol days and one normal. In the first experiment 30 gr. of alcohol were used and in the second 60 gr. The problem was to write as fast as possible the numbers 12345678910 twice, and then 01987654321 once, the letters *inm,* with no dot on the i, and, finally, to draw a line ten cm. long between two points. These thirty-four signs were repeated every day, at first after five minutes intervals, then always after fifteen minutes. On the alcohol days the dose was taken after the first experiment was made. On the normal days the experiment lasted in the first series fifty minutes and on the alcohol days one hour and fifty minutes. In the second series the experiment lasted one hour and thirty-five minutes. They all began at eight o'clock in the morning.

The time it took to perform the different parts as well as the whole experiment was taken down in one hundredths

of a second. The length the pen had to travel upon the paper was also measured, and the time it took to write each mm. was figured out. An account was taken of the pauses between the experiments and the pressure the hand exerted upon the pen.

Mayer compared his results with those of similar experiments made by Diehl and found that his results were as a rule more regular and reliable. This he attributes to education, Diehl's observers being uneducated.

In his own experiments Mayer found that the "Schreibweg" was not very much influenced by alcohol, but that the mm-time, the measure of speed, was decidedly prolonged in the alcohol experiments. This is also shown in the time it took to perform the different parts of the experiments. The movements made in writing were not accelerated but decidedly slower especially after the larger doses. The effect began to show itself about five minutes after the alcohol had been taken and lasted during the whole experiment. It was least in the easiest problem, the writing of mm. The pauses between the single parts were decreased by the smaller doses and increased by the larger, but this was not very marked. The pressure exerted was apparently independent of alcohol. It increased at the beginning of the experiment and after small doses of alcohol; later it decreased, as it did also after larger doses.

Thus he found that alcohol makes the movements in writing slower, shortens the pause, and lowers the pressure in small doses; increases the pause and raises the pressure in larger doses; and that the fluctuation of pressure in written signs are shorter and lower.

Experiments on mental fatigue performed by Rivers simultaneously with his experiments on physical fatigue show that the numbers of multiplications performed in each period increase in the periods of the first half of the experiment while they decrease in the second half; this suggests an injurious effect of alcohol. The increase due to practice shown in the fourth experiment is much less than that in the second; this again suggests an injurious effect upon the work. The tests made on typewriting show the same thing. There is, to be sure, some increase in the amount of work done; but this is very little and irregular and accompanied by an increase both in corrected and uncorrected errors, especially in the former.

To test the influence of alcohol upon attention, McDougall (10) displayed a series of dots on a revolving drum, one by one, and asked his observers to mark them as accurately as they could. The slit in which the dots were shown was

only fifteen mm. wide, and the drum revolved so fast as to require a maximum of attention. The series repeated day by day gave closely parallel results, but the errors made varied considerably at different hours of the same day. The series was then repeated with doses of tea and alcohol. The result of the whole experiment given in errors was as follows:

	Normal.	Alcohol.	Tea.
First series (four papers)....	374	583	273
Second series (three papers)...	298	351	291

The observers were aware that both alcohol and tea were given them, and McDougall says it would have been much better if this source of error could have been overcome, since he obtained negative results with only 15 gr. of alcohol but positive with larger doses. The numbers of errors, as is seen, is much larger on the alcohol day than on the normal; this shows that alcohol impaired the power of attention to a considerable degree.

Specht (19) attempted to find out whether the limina of discrimination and stimulation are changed under the influence of alcohol or not. As material he used primarily sounds. He found that these limina were affected in opposite directions: The discrimination limen was raised and the stimulus limen lowered; but the degree of the change was dependent upon the doses of alcohol taken. The difference was only quantitative, but false judgments are more frequent under the influence of alcohol.

The feeling of activity or exertion, prominent in the normal experiment, subsided, and the observers became more passive with consciousness narrowed down to the expected sensation. Other sensations which would disturb the sound sensations were excluded and the observers reported that they heard nothing of the noise made by the apparatus in the room.

Busch (2) undertook an investigation on the effect of alcohol upon the "clearness and extent of the optical consciousness." Kraepelin, Specht, and others had found a decrease in the mental activity, but it might be objected that, when letters or syllables are used as stimulus objects in the tachistoscopical experiments, the attention is possibly not changed but only the ability to associate and assimilate the partly seen elements limited or enlarged. There is also a possibility that one image may be transformed into another, i. e., auditory into visual, and so escape the possible check that may be brought to bear upon a certain kind of image, especially if this kind of image is less developed in the observer. For the most part, only the clearest part of consciousness has been

taken into consideration. The other parts have been left unconsidered, and in connection with them Busch undertook his work. For this reason he gave his observers a complex picture, larger than their clearest point of vision could comprehend at one time. The observers were asked to look at one point steadily and then try to comprehend what was not in the direct vision. The new stimulus fell thus on parts of indirect vision which possess different degrees of clearness. In this way it was possible to measure the clearness of these parts and the regularity with which the different parts of the picture were comprehended or present in consciousness. The physical differences of the retina must, of course, be taken into consideration in this kind of experiment. In order to do this the complex figure was so changed that every part of the same was given an equal setting, but always so that the fixation point remained the same.

The dose of alcohol taken was 30 ccm, which in most persons would show some effect but cause no bad after effect. One hundred cards on which were written either numbers or letters were exposed to the observer for 17 seconds and he was asked to reproduce from memory what he saw.

Busch, who was most interested in the psychic effect of alcohol found a decided decrease in the tachistoscopic perception of simple visual stimuli. The degree of conscious clearness of the whole visual field he found to be lower on alcohol days than on normal. And yet there appeared in unbroken clearness one district of relatively more perfect perception than another, the limits between the two having approximately the same course as before. But the observation was no longer equally distributed over these fields. There was a tendency to turn away from the more obscure zones and to narrow down the field of consciousness.

More remote illusory phenomena often of a visual nature point to a relation between alcohol and the pathology of the visual organs and the visual disturbances in delirium tremens. These phenomena were especially striking during the first days and were followed more and more by an increasing sleepiness. The subjective effect appeared thereby somewhat later, but lasted, on the other hand, much longer.

The inference, Busch thinks, may be near at hand that the same holds true for the auditory perception, although he has not entered into this field with his investigation.

Busch feels justified in concluding that alcohol in smaller and medium doses disturbs the psychic functions and arouses the activity of the sensory and motor systems. Kraepelin found that alcohol influenced the motor field of activity at

first increasingly and later decreasingly. Busch's investigation confirmed also the peculiar contradictions in the effect of alcohol. "A decrease of the optical consciousness in clearness and extent stands against an increase in physical and sensory activity. And this contradiction seems to be true in a larger measure for both psychic and physical functions. Perhaps it has not yet been pointed out in all physical activities that may come into consideration. Some mental fields are not yet investigated, and a further investigation of the visual sense with thorough methods, as a test of our results, would be welcome." One psychic activity may influence another. The pure feeling processes seem to be more affected than any other. An investigation of these would therefore be of great interest. The observers seemed never to become accustomed to the dose.

Hildebrandt (4) in his experiment on the effect of alcohol upon voluntary action, performed under the inspiration of Narziss Ach, found rather interesting results. He used the Müller and Schuman method of letters and nonsense syllables and divided his experiment into three parts. The observer was directed as follows: 1, Pronounce the first syllable that comes into consciousness after the stimulus. 2, Transpose the consonants at the beginning and the end of the syllable, but do not read from right to left. 3, Think of all the words that rhyme with the syllable. The syllables were presented on a revolving drum. After each sitting the observer was asked to tell what he had experienced—to introspect upon the mental processes employed in the experiment.

Since in this paper we are not interested in the mental processes *per se* but in the effect of alcohol upon them, we shall immediately turn to the results of the investigation.

The possibility of determination, the volitional power itself, is apparently not influenced by alcohol, but those factors which cause the concentration of the volitional power. This effect may, as a rule, be counterbalanced in doses of 50 ccm. alcohol by the consciousness of the changed condition in which the observer knows he is, so that the alcohol does not even diminish the objective results; these on the contrary are often increased with the customary quantities of alcohol taken, since the consciousness of the changed condition causes a stronger concentration of the volitional power.

That alcohol has a detrimental effect upon perception is a notion which has gained widespread acceptance, especially since Krapelin's and Ach's investigations. Hildebrandt found that this may be true but not to such an extent as was supposed.

The well established, mechanical associations are not affected by alcohol, at least not to any great extent. But if the association is not strong a disturbance occurs. This was more clearly noticed in the experiments with 100 ccm. alcohol. In 42 experiments with 50 ccm. the established association failed only once, while it failed four times in the normal experiment.

False reactions were seen both in the alcoholic and normal experiments and in all probability depended upon a weakened volitional tension. But they are sometimes the result of motor excitement, which was present both in the alcohol and normal experiments. This as a rule is not favorable to the right solution of a problem.

It was also noticed that the strength of the determination alone determined the degree of the volitional effect, and that the power to react in the right way, i.e., the ability to determine conditionally the course of the event, the volitional power itself, was in no way affected by alcohol.

This is quite contrary to the results of former investigations. Kraepelin, Kürz, Rüdin and others had found that perception was generally impaired by alcohol and that a change appeared in the motor and sensory irritability in conformity to the quantity of the dose taken. In Hildebrandt's experiments with 50 ccm. alcohol this effect upon perception was counterbalanced by a greater concentration of the volitional power brought about by the consciousness of the changed condition. In the experiments with 100 ccm, perception was, however, poorer but never so poor that voluntary action was impossible. Rüdin found, as Kraepelin had done before, that the time it took to make a choice reaction was decreased by alcohol and the number of false reactions increased. From this he inferred that alcohol caused a decrease in the volitional ability. But the question of the influence of alcohol upon the will is not so easily solved. In order to make the volitional acts approachable in their most energetic forms in observation, it is necessary to counterbalance the factors which oppose them. This Hildebrandt sought to do by employing the associative reproductive tendencies. Kraepelin and Rüdin were satisfied with reaction experiments in which no special volitional tension was necessary. A decrease in time and an increase in false reactions noticed by them belong particularly to the motor mode of reactions and not to annulments of volitional power.

In Hildebrandt's investigation the object was to study the short intermittent volitional acts during the experiment, between which the observers had time to rest. A new decision to perform the experiment in a right way could be made before

the next experiment began, and this enabled them to do the prescribed task. The possibility of concentrating the volitional power upon a decision was never affected by alcohol.

Hildebrandt points out that this is paralleled in daily life where a person may suddenly be confronted with a difficult or serious problem whose solution under normal conditions requires some concentration, but the individual shows no trace of previous stress and acts rightly, i.e., he makes a new volitional decision.

With 50 ccm. the motor excitement played a subordinate rôle and was also noticed in the normal experiments.

Moll (11, 12) criticizes Kraepelin's experiments maintaining that he wished to prove that even small doses of alcohol are injurious to the nervous system and that he does not support this with sufficiently convincing laboratory experiments. The lack of proof Moll sees primarily in the fact that Kraepelin does not seem to have excluded suggestion and that the new conditions introduced by the experimental arrangements would in part at least cause a change in the results.

To this both Kraepelin and Isserlin (3) reply that it was not the primary object of the experiments to establish the injurious effect of small doses of alcohol. Kraepelin supports total abstinence on ethical and sociological grounds. They maintain that Kraepelin had taken precautions that his observers should not know the outcome of the experiments while these were still going on, and think that he thereby had precluded any idea of suggestion, because the experiments might come out quite different than they expected. Moreover the observers all along the line have reported a feeling of having done more in the alcohol experiments than in the normal. Moll's point is, however, well taken as far as it goes. Suggestion may, to be sure, play a great rôle and very easily comes in. Rivers tried to exclude the suggestive factor by using a control mixture. In some cases he was successful, but when the dose was a little strong the observers grew suspicious and recognized the effect where they otherwise might not have done so. As we saw in Rivers' experiments, there was a change in the curve when this recognition was made, so there really seems to be some connection between recognition and effect.

Thus we see that more experimentation is needed before we can come to any definite conclusion. At the present time there seem to be many contradictory results; and the individual differences are great; but it can surely be concluded that alcohol impairs every human faculty more or less. This effect is more pronounced in the higher faculties and, of

course, with larger quantities of alcohol. It still remains to be shown that small quantities have a decided detrimental effect upon all kinds of mental activities.

The detrimental effect seems to be shown more in the quality than in the quantity of the work done.

The real effect of alcohol does not appear until some time after the dose is taken, but may last as long as forty-eight hours. A new dose taken during this time reinforces the effect still left of the other. For this reason the effect is cumulative, and chronic alcoholism may be the result.

The effect is different in different individuals; sensory and motor types are most affected.

The question asked in the first part of this paper must necessarily be answered in the negative. Alcohol does not make us more efficient, even if it can not be shown that small quantities impair the human faculties and destroy the human system. If taken in larger quantities, all experiments agree in showing a detrimental effect. In general, while it seems to stimulate the sensitivity, the higher mental powers are depressed.

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ONE CHILD'S STRUGGLE IN THE PREPARATION FOR LIFE

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The grade system takes no account of different mental tendencies. Forcing all types of mind to conform to a grading which suits the average ability in each branch, we are puzzled and indignant because the boy who loves history and literature but hates the incomprehensible maze of arithmetic grows surly and careless when repeatedly held back from possible success on account of his standing in a subject where failure is inevitable.

Once a year we confront certain children who have made good effort and have gained much but not enough to meet our measuring standard, and we say to them that because they have not accomplished more it is as though they had done nothing, they must go back to where they were a year ago and start again.

The child who falls below the average, demands our most patient and earnest study. Is he handicapped by sense defects? Does he have an unusual type of mind not touched by ordinary means but alive with interest upon some out of school topic? Has late entrance into school forced an association with younger children whose less mature attitude is a constant annoyance? Has an ignorant blunder on the part of some teacher left a mental confusion through which clear ideas cannot struggle? Has especial sensitiveness or shyness caused the child to be unduly dominated by the personality of some one in authority? Has he had to deal with especially cramping conditions at home or at school?

Unceasing must be our effort to penetrate into the darkness of the unawakened mind and to search for the spring which may cause illumination. Training, as Mrs. Booth said of "saving," cannot be turned off by machinery. "It must be done by hand."

It is with the hope that some other teacher may be inspired with greater interest in making such efforts that the following record of one case is given.

In February, 1912, I began to tutor H—— D——. The child, eight years and nine months old, was in the second grade and was a source of great anxiety to both parents

and teachers. Her class teacher felt confident that she was not defective, that she "could if she only would," but said that she was doing no good herself and, lacking self-control and concentration, proved a constant annoyance to the class. Severe discipline rendered her less obtrusive but called forth no desirable self-expression.

She could not read a sentence without blundering and miscalling words, and could not be depended upon to spell even the simplest word, although not infrequently she succeeded even with difficult ones. She could not write a page the meaning of which her teachers could decipher.

It was evident that she received too much help in any home assignment, this being due to the inability of an unskilled governess to hold her to her work at all without herself doing too large a share.

H—— showed a lively interest in general class topics, the study of primitive life, nature study, and the like, but she could not make an intelligent recitation because she spoke so rapidly and indistinctly and interrupted her own thought with irrelevant remarks.

The home is one of considerable wealth and good taste. Books by standard authors fill the cases. The family have lived much abroad. All speak French fluently and English with French rapidity. H—— had a French governess from her third to her eighth year and has since had a German governess who speaks English haltingly.

After a serious illness H—— was delicate for some time and had to be guarded from over-exertion. Habits thus formed were hard for the family to break after the need had passed. There lingered indulgence on the one hand, and on the other a helplessness almost prohibitive of independent thought or effort. Great advance has been made in this respect. She not only attends to most of her personal needs but shows gratifying ability to carry small responsibilities imposed upon her.

Excessive carelessness and lack of concentration were the mother's complaints. "We drill her on a certain word until she knows it perfectly and then she writes it all wrong. She is so careless. I do hope you can teach her concentration."

At last I was left alone with my problem, embodied in a blithe, talkative, well-developed little girl, with pretty manners and sweet seriousness not sustained for many consecutive minutes.

As her mother said, she was capable of knowing a thing many times and then missing it. She had the distressing

fumbling habit, started with the wrong letter or too far in or up or down, and then scratched out untidily. None of her work was clear cut and exact, even in error. One paper had certain mistakes. The next corrected these but developed others. A third returned to some of the first and added new ones. Words of criticism had little weight. Obedience to details had never held a high place in her life, and so nearly all that she did was wrong that special points did not stand out in her consciousness.

Often she was very irritating if one regarded immediate issues.

"Spell robin."

"r-a-p"

"No, rob-in."

"i-n"

"No, no, rob-in."

"i-n, r-i-n Rr-x What's 'x for? Is it any good? What are those little spots on the paper? Why must I spell robin? What is spelling good for? Oh, listen, I was in the park and———"

I saw at once that the only possibility of success lay in my so analysing the situation as to work on its separate elements and help the child to see a few of her difficulties singly and face them definitely. She was completely overwhelmed by the complexity of what was to others a simple requirement. Foredoomed to failure, even her sincere efforts won her no encouragement through which she might advance to sustained endeavor. Often knowing that she had "tried hard," she was pronounced "careless" and saw ill-concealed irritation on the faces of those about her.

"What is carelessness of this sort?" I asked myself. I had recently taught a mature woman of good manual dexterity to knit. She mastered the conditions in about two minutes. She enjoyed the work and was eager to make a jacket for her baby niece. Yet she dropped stitches, added new stitches, and had to ravel out her first two day's work. The mistakes were all "careless" because she knew better. None of the motions having become reflex, she must give her direct attention simultaneously to eight fingers, two thumbs, two needles, and the yarn, and one or more was neglected.

"First then" thought I, "to treat such carelessness as a moral issue and blame and discourage the child because of it is a grievous wrong. I must be far more than patient with her and show her how to be far more than patient with herself."

For the patience so highly extolled in mothers and teachers I seldom feel enthusiasm. The very word implies resistance to the temptation to be vexed, and I have always observed the tendency of nerves thus strained to snap at important crises. Buoyant determination was more to our purpose. We must both, H—— and I, be so engrossed, she in the slow but conscious mastery of her powers, and I in my scientific study and loving motive, that irritation would be impossible.

The Binet tests showed a mind above the physical age, but it was struggling with strange handicaps. I began to feel my way along the paths described below. Naturally no one element was worked out separately. Each day contributed to my discoveries in all, and these in turn threw light upon other fields. But I shall mention them singly as the simplest way to describe a complex situation.

I. H——'s glasses were said to be very weak and their regular use unessential. Brief observation of work with and without them convinced me that they were of appreciable assistance. I requested her to wear them during my lessons and to take them to school As the weeks passed, however, I became assured that the glasses were not fully corrective. In May H— —was taken to an oculist and her glasses radically altered. She now wears them continuously. Her work is gradually improving, but there has been nothing sufficiently decided to make one feel that the glasses were a determining or even an important factor.

It is especially important that her eyes should transmit correct messages, since she evidently forms visual images of a certain kind very readily. She is constantly discovering fish, birds, heads, and other forms, in clouds, blots of ink, torn edges of paper and elsewhere.

II. Left-handedness. For some time I rated this feature as of first importance. Perhaps I placed it too high. This is a subject upon which I especially desire information.

H—— has always displayed the most marked left-handedness, a characteristic inherited from her father. It was with great difficulty that she learned to tell time, turn a knob, without trial, or form any concepts involving a right-ward impulse. She had been taught to use her right hand in writing and therefore it was rather a mental one-sidedness which I first discovered. When it seemed hopeless to get her to write words I had her take anagrams. After brief study, perhaps two minutes, she could accurately and rapidly arrange the letters to make four words, e. g., weave, basket, rug, carpet, but she began with the last letter and built back-

wards, sometimes at the last of a syllable and worked both ways. Not only did she fail repeatedly if asked to write these same words, but I found that she was silently reproducing the word as it appeared with no transition to sound in her mind. She did not know the words which she was making, denied that she had just learned to spell weave, declared that the second word meant the first meal of the day, and the like. In attempting to write she frequently began with the right letter and mixed the others, e. g., c-p-t-a-r-e for carpet. A few times she began with the wrong letter and when I said distinctly "'car-pet,' what is the first letter?" she would reply with puzzled impatience, "I was going to put c at the first end, but I haven't got there yet."

I spent a morning with her class at school. They were cutting Easter bunnies from tinted paper, the pattern being pinned up in front of them. All in the part of the room near me turned theirs in the same direction as the model. H—— reversed hers. The teacher assured me that she was not regular in such exercises and that the circumstance was merely one of her erratic chances, furthermore that it is not unusual for right-handed children to do this. I thought her doing it at all somewhat significant, but I do not know. Usually when I had her represent diagrammatically an absent scene or picture, she reversed the relative positions of the objects.

Since left-handedness is known to indicate a difference in location of specialized brain centers, I am inclined to feel it wrong to force the right hand to perform the activities which are natural to the left. The objection seemed particularly strong in a case so pronounced as that under consideration. To gain information on this point I consulted the psychology departments of three universities. The letters were far from conclusive. The gist of their opinions may be gathered from the following quotations.

"I find your case a very troublesome one. Your description shows a decidedly abnormal case. The specific symptoms relating to left-handedness and inversion of right and left are very puzzling, and certainly suggest some peculiar lack of coordination between hand and brain. Whether these symptoms are primary or the resultant of some other defects is hard to make out. I do not think that the question of changing back to the left hand represents the whole issue. In general it appears best to let such children follow the natural bent in order to gain the maximum efficiency, and with this once established it is easier to suggest conformity. I do not think the securing of right-handed skill in this case worth the effort it would entail. In other words I do not think that the account at present indicates the nature of the difficulty."

"—— is of the opinion that your little pupil's difficulty in distinguishing right from left, in telling time, etc., has nothing to do with the fact that she is left-handed, but is merely indicative of a state of mental confusion which is likely to clear up under persistent training as she learns to give attention to her work. He thinks there is no reason why she should not be taught to write with her left hand, if this hand has the better co-ordination."

"I do not know of any useful literature on left-handedness and right-handedness, but I am sure that your little girl had better be allowed to use her left hand in future, and that it was a mistake to have her use the right in the past. Do not let her get worried or disturbed in your efforts to counteract the spoiling she has so far received. If her general intelligence is good I would not be disturbed about right and left confusions."

H—— always begged to draw with her left hand and was allowed to do so at school, but when I told her that she might write in the same way if she wished, the little person herself disapproved. "It was so hard to learn to use my right hand. I think it's a pity to lose all that trouble. It might break the habit."

Very recently I have been told by Dr. Wallin of Pittsburg University that there is some reason to believe that the forcing of a left-handed child to use his right hand induces speech defects. It is his opinion, however, that when the right hand has been used for some time with the consequent training of brain centers, the confusion would be enhanced by changing to the left.

H—— liked arithmetic better than any other subject and in oral work she was sensible and fairly accurate. Her written work was poor because she "carried" in the wrong direction and reversed the tens and units figures, e. g., 81 for 18. Looking very rueful she would say, "But the 8 does really come first." I helped her to overcome this by remembering that in all the teens the 1 stood next to the window.

Gradually the most obvious evidences of the reversed field were eliminated. I insisted that words made with anagrams should be built up letter by letter from the left-hand end, and in all our work I tried never to disregard a false statement of position.

III. Hearing, auditory images, detection of tones. By the watch test or response to whispers and low tones, I have detected no deafness in H——, whose hearing is supposed to be normal, yet she is extremely "tone deaf." A skillful music teacher has worked with her for months to get her to distinguish notes on the piano. She has no sense of rhythm, cannot carry a tune, and a year ago rhymes meant

so little to her that she could not tell where the lines of poetry ended. In this she has greatly improved.

When this inability to recognize sounds first became evident to me I thought that she confused similar letters, e. g., m and n, l and r, b r i n d for blind, and the vowel sounds. But it soon developed that she had great difficulty in distinguishing between letters so unrelated as k and t, m and nd, th and wh. Being told to remember "there" she would, after a few minutes' interval repeat "where" or "when." Asked to select from a group of words, e. g., ring, found, grow, and think, the words rhyming with flow and ground, her chances of success or failure were about equal.

"Do 'and' and 'bound' rhyme? Why not? They both end in nd."

Next day, "'Plow' and 'ground' rhyme, don't they?" Then wearily "I don't seem very strong on rhymes."

She suggested that I drill her on her phonetic cards to which she had been led to attach great importance. This was at the time when I felt that some lack of control of the vocal organs caused her to be unable to make certain sounds. However, the sounds of all the letters and combinations th, ck, ing, ch, etc., clicked off as rapidly as I could manipulate the cards. There was no speech defect in the ordinary sense. It seemed to me that this exercise had failed in the beginning to form associations in her mind with practical applications, just as tables or other forms may be memorized as isolated facts. It is recognized, not only that such knowledge does not function, but that it is far more difficult to form the associations later than it would have been before drill made the response so automatic.

This seemed to me to explain in part the fact that difficult words were often recognized in reading when easy ones were miscalled. Their peculiarity made an appeal to her consciousness which the mere combinations of phonetic elements did not make.

Sometimes, but not regularly, she could be made to sound the elements of a phonetic word, but she frequently made the most ludicrously distorted faces in her efforts to combine the sounds into a word. Gr-ow and gr-ew, for example, afforded us weeks of practice and are not yet mastered with certainty.

When through imitation she could be induced to place her lips and tongue correctly for the desired sound she promptly named the right letter.

It was weeks before I fully realized to what an extent she

had conceived false images of common words. I have wondered whether the foreign languages which she has heard and spoken rapidly and indistinctly had any bearing on the situation. She was surprised, annoyed, indifferent, and finally ashamed and vitally interested at the discovery that she "did not even know how to talk." She had "A hansen book of Robberloo Steefuse's pomes." "Her grammother" lived with the family. An "obolust" fitted her glasses. She played with "Effel." She had six "zampols zakly" right. They went to the "drubburst" for soda water. Sentences begin with "captofal" letters. It is only very recently that she can detect a difference between singulars and plurals.

It is evident from examining the above list that she was not unable to say the th or v or f or t. She simply did not hear those sounds in those particular words. It seems scarcely reasonable to associate this peculiarity in speech with the treatment given her left-handedness, since the misconception of words manifested itself before she was taught to write.

In this field has lain my most definite and persistent work, and it has not been altogether without results. I made a type-written list of the words which she mutilated in her conversation. This we practiced daily. Each day I took the school assigned spelling lesson and made her spell all the phonetic words without study. This has given her a great sense of power. I taught her to watch my lips and herself to pronounce each word very clearly. When she was given the remainder of the words to study she knew that there was some important point for her to notice in each, thus associating the study of spelling with close observation of details, an idea hard to attain when "phonetic" and "hard" words are given together. Anagrams have been of great assistance. When she wrote I had her pronounce each letter aloud as she made it, so as to insure all possible impressions. I never allow her to copy a word several times for study without thus repeating the letters aloud.

We played games of observation to see how many words she could see in ten seconds, how many tall letters were in a given set, how many loops and the like. I have avoided letting her look at the paper with mistakes on it, but instead have written correctly the words on which she failed and have given her my copy to study.

Absolute failure is not unusual. After she has heard and said and studied "fruit" with all the methods I can devise for producing distinct visual, auditory, and muscular images,

she suddenly writes it " f-l-u-i-t," and asked to say the word replies " floot."

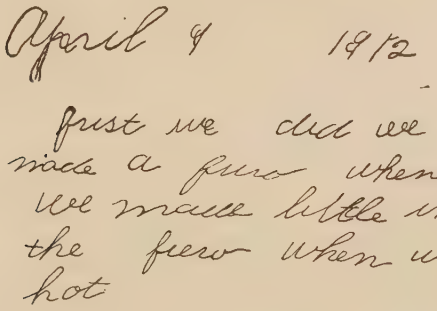
Despite her poor manual control which results in the poor form of some letters, H—— seems to me to have the making of a good writer. She prides herself upon holding her pencil very loosely and making nice large letters with round sweeps. Her false strokes and much scratching out made her papers untidy for a long time, but this was rather because of the uncertainty of what she was to write than a defect in penmanship. Recently she has acquired pride in her " nice, clean words," which look as " decided and smooth as if a teacher had made them."

Dictation exercises given for the purpose of teaching correct form in the written page she disliked so much that their execution was perfunctory and practically valueless. She wanted to be saying real things, yet the difficulties were so great that she could not make us know what her smears and false strokes meant.

One day her teacher gave me the following " composition " which H—— had written at school. I showed it to her saying that we could make nothing of it, and refusing to allow her to explain. She was to make it intelligible by writing. I was to sit behind her and not see the paper till it was finished, but would write any word for her to copy. Such words were to be underscored to indicate their not being hers. The second trial shows the result. The checked words she spelled herself with assistance, i. e., by having me speak them very distinctly but not say any letter.

I then wrote the sentences at her dictation and after studying my paper she produced the " third trial."

First Trial



SECOND TRIAL

April 9 192

The first thing we did
we made a furrow.

Then we made hole in
the furrow

And put the seeds
in the hole

Then we covered with
earth.

THIRD TRIAL

April 9, 1912

The first thing we
did made a furrow
Then we made holes
in the furrow and
put the seeds in the
furrow
Then we covered
them with earth
now we will see
how they grow

Since that time we have executed many compositions, to her increasing delight. There is never a dearth of topics or subject matter; for her mind is ever alert and little escapes her quick eyes.

In response to her desire to give to her writings a distinguished appearance she even gave heed to margins and headings, and she now takes dictation lessons in the spirit in which they were planned, as formal training to help her when she needs to have her mind free for subject matter. Not content with humdrum sentences she tries picturesque expressions.

"The Indian must needs."

"But you don't talk that way."

"I know, but let me write it. I love to. It sounds so quaint." "Will you show me how to put in the little marks to show that he is talking?" "Can't I *puncherate* it to show that he was glad?"

Hard words are copied in silence so as not to interrupt the thought. Her accurate copying has been a source of interest to me. Increasingly she attempts words herself, or turning gravely watches my lips in silence. "Will you say 'leaf' for me? I don't know whether to make l or f first." "Is it m or n in farmer?"

It is a curious fact that while my efforts served to push her past the barriers where she seemed hopelessly lodged and to give her power to advance, they did little towards removing the specific stumbling blocks associated with past confusion. She seldom reads "where" without first calling it "there" and in any spelling lesson the words missed are usually those on which I drilled her ineffectually nearly a year ago. Written spelling still lags far behind oral.

We think of the reversed field as largely overcome, yet occasionally she fails to tell time because she feels the hands as moving backward, adds the hundreds column first, writes "04" for "40," or calls "ashes" "sashes," i. e., starts with the sound of the letter at the end.

In the beginning I was amused at being asked to teach "concentration." As the weeks passed H—— and I were so busy that I finally awoke with the startled consciousness that I was not planning for this point at all. Concentration is not an end, but only the evidence of an absorbing interest aided by effective habits of study.

From the first we attended rigorously to business. "No, never mind that now. Put on your glasses. You have rubbed them enough. Ready, spell robin, now sparrow; don't look out the window, now nest." But from the first we had a great deal of fun, for I strove to invest each act of drudgery

with all possible interest. We must all learn to will to do unpleasant things, but I doubt our being greatly helped to do them by our own will through being forced to do them against our will.

Two daily record charts which H—— herself marked with red ink on coordinate paper afforded great delight and a tangible means of measuring progress in certain lines. One showed the number of words correctly pronounced in one minute from the typewritten list already explained. The second chart set forth in glowing colors the number of examples like the following, added correctly in five minutes:

36	67	42	52	35	42	93
45	84	65	68	74	62	62
72	35	27	95	36	85	68
—	—	—	—	—	—	—

Beyond a brief introductory word of advice nothing was said to repress talk during these time tests. But such interruptions obviously hindered in breaking records and soon ceased. That was a proud day for us when H——'s father entered the room and after a glance at my warning finger retired in puzzled silence to a window while the little girl added on intently, and exceeded her past record too.

"I didn't just not talk," she said eagerly, "I thought, 'I must add, I must add,' and I did more than ever before."

Life cannot be all play, however. Stern drudgery comes to all of us. There were days such as the one on which I said, "I have told you again and again to be careful about your s's, and you are not trying at all. Now make a whole line of s's."

"Wh————y?"

"Because I say so and right away,————Now another."

"Why?"

"Because you waste time saying, 'Why?' and don't make them well. Now another."

Nor would children have a world all play and caprice if they could. We wrong the little men and women in the children when we assume that they must be forever amused, and we are often humbled at the discovery of what earnest little men and women they are. I was especially impressed with how much keener interest H—— showed when she saw the inner purpose of a task than when the fun was merely that of a devised game.

One phrase in a letter quoted above was often in my mind, "Do not let her get worried or disturbed——" and I strove to shield her from the overwhelming sense of failure which

may easily come to hang like shackles about such a child, and to point her to the light ahead, "You failed to-day, but to-morrow you will do it."

This was far from easy, as she was by no means in the pathetic stage of discouragement. Constant reiteration of her faults was already bearing its most dangerous fruit in making her defiant or self-assertive. She was intoxicated by the most moderate praise and ceased from all endeavor in order to bask in the unwonted sunshine. To keep her courage high through daily failure and yet not develop overweening conceit and passive satisfaction in petty achievement taxed my resources to their utmost.

I worked for intelligent cooperation. The purpose in much that I did was so far beyond her that she did not even wonder. But whenever possible I tried not merely to let her see my immediate end but to enable her to catch a glimpse of the ultimate issue. For a long time we had been working on clear pronunciation. I constantly trippped up her conversation, often greatly annoying her. One day she was repeating the word after me with almost sullen indifference. "No, no, H——," I said, "you mustn't think it does not matter when I try to make you speak correctly. If I can teach you how to talk you will almost know how to spell. For instance, spell this word we were just saying—violet."

"It is too hard. I never studied it."

"I know, but spell it."

"v-i——o" a deep gulp and duck of the head, "l-e-t."

"Now spell capital."

"Can I spell that?"

"Certainly."

"c-a-p———i———t-l-e, tal, tal, no, t-a-l."

"That is correct."

"Oh!" she cried with face all aglow, "I'm learning to spell, I'm learning to spell."

Next day when I corrected her on the pronunciation of her little friend's name she laughed gaily as she answered, "Ethel." Then roguishly patting my arm to keep me quiet she continued, "And an oc-u-list fitted my glasses, and I begin with cap-i-tal letters, and I went to the druggist," etc., etc. A moment later, "Could I spell all those words?"

"Probably not."

"Do you think I could spell half? I'm learning to spell pretty fast."

This was very different from her former flippant conceit. It was a piece of self-knowledge and realization that among

the many faults she was consciously attacking and overcoming certain ones.

After a summer of play and desultory study with a governess, H—— returned to school in good health and with the desire to do her work well, but with much of her former roving attention. The slightest sound diverted her.

It was impossible to promote H—— to do the regular Third Grade work, yet she was too old and sensible to make a repetition of Second Grade desirable.

By a special arrangement she was received into the Fourth Grade of our Open Air Department with the understanding that she should be helped to advance according to her own needs in each subject.

Easily keeping pace with the Fourth Grade children in geography, history, and literature, when the text was read to her, for several months she had all her reading and spelling alone. During the year she has covered Third Grade arithmetic, except that her poor form makes written examples very hard to attain. Her reasoning is good. Her inattention was speedily overcome to a very marked degree. It frequently happened that recess was the only time in which her special reading lessons could be arranged, but the little girl never uttered a word of complaint when led away. "Here I am, Miss ———," called her cheery little voice as she caught sight of the teacher with her book. She read steadily within sight of her playing companions. Teachers and pupils united to drill her on her Tables and I have more than once had to interfere when all her play time was preempted to finish an unreasonably long task assigned by an older child. Not only did she never complain but reported the fact if she was too long neglected. "I will get backward if no one asks me anything," she said.

By the first of February she was reading well in second readers, frequently miscalling words but generally able to correct herself, her running comments meanwhile leaving no doubt of her thorough understanding.

About the middle of February she was started in a third reader. But at that time the Fourth Grade began "Viking Tales." H—— was entranced by the story, annoyed when a child read haltingly or did not give the meaning, and more and more strove to follow the story on the page before her. One day, with a sudden inspiration, she begged to be allowed to read, and with a sudden inspiration the teacher consented. The performance was not a perfect success but it was far from proving a failure. At the end of the lesson she was ready with a new request, if she took the book home and

prepared what was sight reading to the others, would she be permitted to read with the class? The battle was won that day as far as reading was concerned, for she has read with the Fourth Grade ever since, soon at sight with the more advanced section.

In April I found her in the back of the room, reading softly to a child who was unable to use her eyes that day, and stopping to explain, "May be if S—— could use her eyes she could read better than I could, but she doesn't know what it means, so what's the use? I just splain it to her."

The difficulty which seems to me now the most baffling is the child's inability to receive, retain, and reproduce distinct words. I cannot understand how she can have so clear an appreciation of what occurs around her when the language which is the vehicle for most of our expression buzzes about her so inarticulately as it seems to do. There is seldom a day when she does not ask me the meaning of some impossible word which she has understood to be said in a recitation or conversation, often combining two or more words, e. g., watell for "wait till." Ideas seem the essentials but it is difficult to advance satisfactorily without some terminology. I am pleased with her multiplication and division, but I could not help being distressed at the discovery a few days ago that despite my efforts to speak very clearly she is talking of "mulipation" and "vision." It is out of the question to spend weeks of drill on every new word.

With obviously clear understanding, expressive gestures and excellent illustrations, she cannot relate the simplest incident without slurring her words till they are barely intelligible and frequently asking for help with names or big words. "And then M——, what was the little Japanese girl's name?" "The water comes rushing through———what do they call a 'specially big, deep valley?" I entered the room recently when the class was trying to trace the course of the Delaware river. Her finger followed the crooked black line readily enough but at the same time she was making ineffectual efforts to explain an experience of her own during the summer. Knowing that I knew the facts she hailed me to her assistance. "Where was I on that trip last summer? Something about Delever?"

"At the Delaware Water Gap," I said.

"Oh, yes," she exclaimed to the class and teacher, "I was at the Delerergap."

Even more puzzling is it when in reading she calls a word something totally wrong, e. g., says "potatoes" for "pictures," but looks up with a perfectly sensible remark about pictures.

The sound and sensation of saying "potatoes" does not make it impossible for her in some way to gain the correct idea from the symbols before her eyes.

In writing, the advance is much less rapid than in reading. In any original production her mind is so full of what she wishes to say that she dashes heedlessly on with little regard to form, not even taking time to realize that she needs to ask for help. The results, though often better in thought than those of most of the class, are indecipherable by any but the initiated teacher, and not wholly intelligible to her. Poor H—— looks very foolish and rueful when forced to listen to the jargon of sounds produced when such a composition is read literally according to the letters set down.

In dictation exercises the advance is more gratifying. It is disconcerting to see her write d-o-r-p, at the end of a series of exercises about a rain drop, with drop correctly spelled a dozen times, or to watch her read "dark" and spell it to herself d-a-r-k and then write drach. Yet we now feel that it is fair to count these mistakes as careless, even though the child appears to be trying, for, when sufficient stress is laid upon accuracy and she is held to this task for some time to the exclusion of more pleasant experiences, a practically perfect paper results.

One of the most instructive features of her case, because of its reflection upon conventional school grading, is the fact that since she is not held back in all subjects to the level of her lowest attainment, she is no longer troublesome. Happy, alert, full of ideas, she has ceased to be a noisy or officious member of her class. Instead of selfish disregard for the rights of others she expresses the kindliest feeling and recognition of just relations.

It is our hope that, with much special consideration for her weak points, she will be able to do reasonably strong work in the Fifth Grade next year.

The following specimen of her independent work shows her improvement. It is the first paragraph of the reproduction of a story.

may 15 1913 #

The Wind and Moon

"I hate to be
staréd at in the
face" said the wind
to the moon. The
Wind said, I'll
blown you out and
then You will not
stare at me or
I will blow you
out one tow three
and here! you go
out The wind blew
hard and went the moon
The wind said The
moon its out now
I can sleep now.

ORDERLY ASSOCIATION AS A CONDITION OF MENTAL HEALTH

By Wm. H. Burnham

The essential conditions of healthful mental activity are many, both physical and psychic. The problem of determining these conditions is so complex that its solution seems well nigh hopeless, and yet here modern psychology comes to our aid and suggests certain unifying principles (6). Two of these are of fundamental importance, namely, the following: 1. Attention to the present situation; 2. Habits of orderly association.

The most primitive and fundamental mental function is perhaps what we call attention. While structurally attention means clearness, genetically and functionally it means a reaction of the organism comparable to the tropisms in plants and animals. The usual form of attention is reaction to a group of stimuli immediately present, what may be called the present situation. The type of *healthful* attention is everywhere attention to the present situation. So important is this for the mental health that one's ability to concentrate upon the present, ignoring the past and the future except as vitally related to the present, is in a certain sense, a gauge of one's sanity. This was pointed out long ago by Janet, and the importance to health of living in the present has been emphasized recently by Dr. Osler in his lectures at Yale. "Sufficient unto the day is the evil thereof," represents the soundest mental hygiene, and the danger of ignoring this is shown by modern psychiatry.

In the border line neuroses, e.g., the patient worries about the past or has grave anxieties about the future. The beginning and the cause as well as a characteristic symptom of mental breakdown is the habit of doing things, as Pres. Hyde has suggested, three times, which should be done but once: 1st, doing them in anticipation and dread; 2nd, in the actual occurrence; 3rd, in worrying about them afterwards and regretting that they had not been done differently.

The second fundamental mental function is association. The law of association in the mental world has aptly been compared to the law of gravitation in the physical world; and for the mental health, orderly association is of fundamental significance. Conversely, if we should attempt to sum up in

one word the things that menace the mental health, this might be done best perhaps under the term interference of association.

From a practical point of view these two principles are one, because attention to the present implies orderly association; and on the other hand, habits of orderly association presuppose attention to the present situation and make this easy and natural. In fact, attention to the present situation is often the best possible device for avoiding interference of association. This has always been the refuge of men in times of crisis and the anchor of sanity and health in the stress of intolerable circumstance. The mental attitude is what Plato called singlemindedness. While attention may be distributed, it should not be distracted by the complexity of a situation; and from such singlemindedness or unity of attention will be developed habits of orderly association in distinction from interference of association, which commonly occurs as the result of bad training, extreme fatigue, and nervous disorder.

Interference of Association

From the point of view of mental hygiene the chief aim of education may be said to be the development of right habits of association; and the avoidance of interference of association is the most general negative rule in mental hygiene. What is signified by this can be shown best by illustration. We find interference of association in an infinite number of forms from the conflict of simultaneous stimuli in the nervous system and the relatively simple interference of incipient motor habits up to the confusion of thought in the individual who is worried or rattled or the patient who suffers from the insanity of doubt. It is illustrated in the most ordinary experiences of daily life as well as in experiment. A few concrete examples may be helpful.

In many forms of experiment in the laboratory we have simple illustrations of interference of association. Bergström (3) found it in sorting cards, where in the first half of the experiments the cards were sorted into ten piles located in a certain way, and in the second half into piles differently located. Bair (2) in experiments with the typewriter and in sorting cards, noticed the same, although his results led him to conclude that there is less interference than Bergström found; but he also found evidence that "diverse associations become automatic with practice and that the neural disposition of the old habit does not vanish when a new one is formed." Müller and Pilzecker (20) found that when a series of

nonsense syllables has been learned, a later test shows that less is retained in case a task demanding concentration—the careful consideration of pictures, for example—be given the observer immediately after the learning. Culler (7) in more recent experiments with the typewriter and in repeating Bergström's experiments, found that " interference is an incident in the course of automatization of the two opposing associations." Interference is found also incidentally in many laboratory investigations, and it is illustrated in learning typewriting, stenography and the like. It is liable to occur anywhere during the processes of learning before the series of associations is thoroughly organizezd.

Laboratory experiments on the acquisition of skill furnish innumerable illustrations of the law of interference of association; and the recent investigations by the so-called *diagnostische Assoziations-methode* (17) give noteworthy examples. Specially significant is the fact that if the associations have a distinctly affective character, interference is likely to result. The normal association reaction time is from one and a half to two seconds, but where the associations arouse distinct feelings, the reaction time may be six or eight or ten seconds. If, for example, the associations concerned relate to the affairs of one's own family, especially if there be domestic friction or the like, or if a crime has been committed, or if for any reason strong feeling be involved, the association reaction-time is likely to be enormously lengthened. Thus, some have rather hastily inferred that the association method can be used in the court room to determine the guilt or innocence of a prisoner on trial. The reason for this lengthened association reaction-time is the strong feeling aroused, at least, in many cases. But, on the other hand, there may be a lengthened reaction-time for many other reasons, and anything, in fact, which causes interference of association is likely to lengthen the reaction.

Such experimental results show in the most emphatic manner, in the first place, the great waste of time when interference of association occurs, and from a hygienic point of view the great stress and strain likely to be involved in the mental processes wherever interference occurs; even when a minimum of feeling is involved, the mental process is allied to the arch enemy of the mental health, namely, worry.

Perhaps the most important point hygienically is the relation of interference of association to feeling. Whenever attention to two things is demanded, one of which is strongly affective in character, interference is sure to occur. And while feeling causes interference of association, interference,

on the other hand, is usually the beginning and a condition of feeling.

Interference of association is most vividly illustrated by numerous pathological cases. In extreme instances the patient seems to be always thinking of two different things at once, and clear-cut reactions are impossible. The so-called imperative ideas are often so many cases in point. The various phobias, pyrophobia, fear of fire, mysophobia, fear of dirt, claustraphobia, fear of open places, and the like, furnish examples. The extreme form of interference of association and worry is well illustrated by the so-called obsessions. These occur in great variety from obsessions in regard to one's physical health or one's soul's salvation to the slight temporary obsessions where a nonsense rhyme or an absurd image persists in consciousness.

The pathological and the bizarre, however, merely paint in lurid colors the normal. Every association of ideas is to a certain degree imperative. This is admirably illustrated by an old story probably often quoted. An alchemist, so the tale runs, discovered a formula of mystic words which enabled one to turn baser metals into gold. Only this condition was essential, namely, that when one repeated the mystic formula one should not think of a hippopotamus. On this condition it was sure to succeed, but no one ever made gold by using it because no one was ever able to comply with the necessary requirement. This story illustrates the imperative character of our associations. In a certain number of cases, if we have once seen or heard the irrelevant, interference of association is inevitable; in all cases it is possible. If our minds have once wandered to the unessential, such ideas are always liable to come up to our confusion. This is the tragedy of education. Inaccuracy in learning, the mistakes of a poor teacher, the results of a slipshod method, can hardly be atoned for. If a child associates a wrong pronunciation with a word, or makes an erroneous association in arithmetic or falls into error in grammar, the wrong association is almost sure to be remembered and causes confusion even if actual error does not result. The pupil cannot escape from it. He may know what is right, but the erroneous associations come to mind first and cause interference.

Many normal people are never straightforward in their processes of thought. They are always thinking of two things at once; or if one subject holds the focus of attention other things are in the background or indirect field of consciousness and liable always to interfere and cause distraction. All of us at times have this experience. Waiting for an

important engagement, a forgotten duty, uncertainty about a verdict, unfaithfulness to an ideal, and the like, are occasions for it; and every individual in the stress of circumstance from the collapsing financier to the rattled baseball player furnishes illustration.

Even in our recreations and athletic sports interference of association is likely to be the most serious menace to success. Of drop kicking in football, Brickley, the Harvard football player says:*

"The 'concentration' part of it comes when you are receiving the ball from the centre. Then the least fumble or juggle is pretty sure to kill the kick. If while you are waiting for the ball to come back you happen to see something go wrong in the line or get the feeling that your protectors in the backfield are not in just the right places, there's a big temptation to let your mind wander from the business at hand. Even after the pass has started, these things seem to flash across your mind. If you let them jar you or if you let any sort of an interruption 'get you' you're a goner. Nine times out of ten the kick goes wrong.

"A great many times you will get a kick away thinking of nothing else than that some one of the opposing linemen must have been offside or else he could not have broken through so swiftly. If you let it worry you the kick is sure to go bad. As a matter of fact if you had your eye on the ball you didn't see it at all. You 'sensed' it. Anyway, drop kicking depends, to my way of thinking, upon keeping your eye and your mind on the ball from the moment you have taken your position and sized up the angle and the distance."

Under certain conditions even attention itself may be the cause of interference of association. Too close attention to an action to be performed is apt to retard or inhibit it. This has been found in many experiments in the laboratory, in pathological cases, and in common experience. What the conjurer tells his audience is often true in daily life,—"the more closely you give attention the less you see." From such phenomena De Sanctis has formulated the law of contrary association. As he puts it, a certain forced exercise of the faculty of attention inhibits and removes the idea to which it is directed and thus favors a contradiction and a predominance of the contrary association.

This law of contrary association has a wide application. The extreme cases of interference of association, as seen in certain forms of nervous disorder, are perhaps cases in point. Neurasthenics sometimes complain that they see the opposite word to that desired, and the impulse to blasphemy and the like in cases of religious neurotics are also noteworthy. In a case reported by Dr. Pick,* the patient presented among other

* *Boston Sunday Herald*, Nov. 17, 1912.

* Journal of Nervous and Mental Disease, vol. xxxi, No. 1, Jan., 1904. pp. 1-14.

symptoms that of giving a contrary reply to questions asked. The following conversation gives an illustration:

"Have you a Christian name?" "No."
"Then you have no Christian name?" "Yes, Joseph."
"Are you married?" "No."
"Then you are single? "No, I am married."
And again, "Do you know the examiner?" "No."
"Hence you do not know me?" "Yes, I know you."
"Do you always behave so?" "No."
"Then you do not always act so?" "Yes."

In some of the cases reported the contrary reaction seems to be due to purely motor interference. A case was reported by Meschede where a forced movement was always carried out in the direction the opposite of the one intended. This occurred only when the patient himself intended to move or when he was ordered to do so. If the patient desired to look to the left, the eye-balls turned actively toward the right. If the patient attempted to look upward, both eye-balls immediately were lowered; and during convalescence, if we may trust the account, the voluntary movements of the entire body were in like manner carried out in a direction opposite to the one desired.* Dr. Weir Mitchell (19) has also reported cases of this kind, among them the following:

A naval officer after a period of unusual strain during the war of the Rebellion found that when on the landing of the stair-case intending to go up the next flight, instead of doing so, he found himself going down the flight he had just ascended and going down backward. Afterwards at long intervals and when over-worked such reversal occurred. "In the street if the action of walking suddenly ceased to be automatic and he recalled the fact that he was walking, he would sometimes walk backward a few steps, and finally recovering himself would go on as before. After a while he had great difficulty in ascending the stairs in the usual way, and was ordinarily unable without effort to go upstairs foremost. When he was alone he was apt to go up backward, and generally if not watched descended the stairs in the same way. He would go to a door to unlock it and would find himself making an effort to lock it."* This symptom was not a serious one; the man continued to be efficient in the ordinary affairs of life, and during the years of this peculiarity he served in the war with distinction. Another case was that of a lady who had the not uncommon habit of turning to the

* See Journal of Nervous and Mental Diseases, loc. cit. p. 9.
* Journal of Nervous and Mental Disease, Vol. xxxi, No. 4, April, 1903. pp. 193 *seq.*

end of a book before she began to read in the usual way; later she had the tendency to go backward through the book with some mental confusion if she tried to read in the ordinary way. Another woman suffering from arterial degeneration and other physical disorder had the tendency to put her shoes on her hands or her gloves on her feet. An officer in the army worn out with service sometimes did the same, and instead of holding his knife in his right hand, held it in his left, although the left was crippled. A dentist had the habit of saying directly the opposite of what he desired,—out of doors, for example, when he meant indoors, a clear day when he meant the opposite. With change of climate and occupation he entirely recovered, and these reversals of statement ceased.

The popular terms for interference of association are worry, nervousness, the conditions of being rattled, confusion of ideas, etc. While worry is a common form of interference of association, the latter is a much broader term, but a large group of illustrations are furnished by the experience of worry. Dr. Walton (29) has given concrete cases in an interesting and useful little pamphlet. A vast number of superstitions and idiosyncrasies on the borderline of the pathological also show interference of association in extreme form. The classic case in literature is that of Samuel Johnson (19) as reported by Boswell. As his biographer reports the case, he suffered from obsessions of various kinds, and at one time interference of association seems to have been a very common phenomenon. As Boswell describes it:

"He had another peculiarity of which none of his friends ever ventured to ask an explanation. It appeared to me some superstitious habit, which he had contracted early, and from which he had never called upon his reason to disentangle him. This was his anxious care to go out or in at a door or passage, by a certain number of steps from a certain point, or at least so as that either his right or his left foot (I am not certain which) should constantly make the first active movement when he came close to the door or passage. Thus I conjecture; for I have, upon innumerable occasions, observed him suddenly stop, and then seem to count his steps with deep earnestness; and when he had neglected or gone wrong in this sort of magical movement I have seen him go back again, put himself in a proper posture to begin the ceremony, and, having gone through it, break from his abstraction, walk briskly on, and join his companion."

Some of Dr. Walton's illustrations are instructive here. For example, he cites the case of a man who leaves his office at night, and then it occurs to him that he has not locked his door. If he is a normal man he goes back and tries the door and then goes home and thinks no more about it. The

neurotic, on the other hand, goes back and tries the door, and then is not satisfied, but goes back again and again. In either case as the man walks away from his office there is interference of association, but in the abnormal case it becomes chronic.

Of the doubting mania, Dr. Walton gives the following example (29, p. 89):

"A gentleman once told me that after mailing a letter he would often linger about the box until the postman arrived, and ask permission to inspect his letter, ostensibly to see if he had put on the stamp, but in fact to reassure himself that he had really mailed the missive, although he knew perfectly well that he had done so. The life of the chronic doubter is full of these small deceits, though in most matters such persons are exceptionally conscientious."

The significance of such doubts for the mental health, Dr. Walton notes as follows (29, p. 93):

"With regard to immediate doubts, if the over-scrupulous business or professional man, worn out after an exacting day's work, will stop and reflect, he will realize that much of his exhaustion is due to his having filled the day with such doubts as whether he is doing the wrong thing, or the right thing at the wrong time, whether he or someone else will miss an appointment or fail to meet obligations, and whether he or his assistants make many blunders."

Among the best illustrations of interference of association are the phenomena of normal and morbid conscientiousness. Men like Napoleon, to whom most matters are not questions of conscience at all, are usually clear in their thought and straight-forward in their action. Men like Amiel, to whom the choice of every phrase is a matter of conscience, are the extreme examples of confusion of association. Amiel's Journal in fact furnishes some of the best possible illustrations of such interference of association.

Of his difficulty in composing he says (1, p. 355):

"I have been working for some hours at my article on Mme. de Staël, but with what labor, what painful effort! When I write for publication every word is misery, and my pen stumbles at every line, so anxious am I to find the ideally best expression, and so great is the number of possibilities which open before me at every step.

"Composition demands a concentration, decision, and pliancy which I no longer possess. I cannot fuse together materials and ideas. If we are to give anything a form we must, so to speak, be the tyrants of it. We must treat our subject brutally, and not be always trembling lest we are doing it wrong. . . . I am always retracing my steps: instead of going forward I work in a circle; I am afraid of having forgotten a point, of having exaggerated an expression, of having used a word out of place, while all the time I ought to have been thinking of essentials and aiming at breadth of treatment. I do not know how to sacrifice anything, how to give up

anything whatever. Hurtful timidity; unprofitable conscientiousness; fatal slavery to detail!"

A similar interference of association may occur, of course, in any other occupation as well as in writing. As more time is spent in reading by most people than in writing, illustrations of habits of interference in reading are probably still more common. The latter are often found among children. George McDonald in *David Elginbrod* has reported an extreme case which, if it be not true, is truthfully invented. Hugh finds his pupil on the floor in a corner of the library reading the old romance of "Polexander," and the following conversation ensues:

"Do you like this very much?" said Hugh.
"Well—no. Yes, rather."
"I think I could find you something more interesting on the book-shelves."
"Oh! please, sir, mayn't I read this?" pleaded Harry, with signs of distress in his pale face.
"Oh, yes, certainly, if you wish. But tell me why you want to read it so very much."
"Because I have set myself to read it through."
"You should not set yourself to read anything before you know whether it is worth reading."
"I could not *help* it. I was forced to say I would."
"To whom?"
"To myself. Mayn't I read it?"

Again Hugh found him in the library, seated in his usual corner, with "Polexander" on his knees.

"It's no use; I *can't* read it."
"What's the matter, Harry?" said his tutor.
"I should like to tell you; but you will laugh at me."
"I shall never laugh at you, Harry."
"Never?"
"No, never."
"Then tell me how I can be sure that I have read this book."
"I do not quite understand you."
"Ah! I was sure nobody could be so stupid as I am. Do you know, Mr. Sutherland, I seem to have read a page from top to bottom sometimes, and when I come to the bottom I know nothing about it, and doubt whether I have read it at all; and then I stare at it all over again, till I grow so queer, and sometimes nearly scream. You see I must be able to say I have read the book."
"Why? Nobody will ever ask you."
"Perhaps not; but you know that is nothing. I want to know that I have read the book; really and truly read it."

While such extreme cases may be unusual, all children as well as many adults in the presence of an uninviting task are likely to show interference of association. An excellent illustration is given by Dr. James:*

* James, Wm.: The Principles of Psychology. New York, 1890. Vol. i. pp. 421.

"I know a person. for example, who will poke the fire, set chairs straight, pick dust-specks from the floor, arrange his table, snatch up the newspaper, take down any book which catches his eye, trim his nails, waste the morning *anyhow,* in short, and all without premeditation,—simply because the only thing he ought to attend to is the preparation of a noonday lesson in formal logic which he detests. Anything but *that!*"

This interference of association is often not clearly conscious. Many illustrations are furnished by the psychology of memory, in every day life. Freud (9), as the result of his investigations, maintains that our thoughts, our acts, our errors in recollection, our mistakes in speech and in act, are not mere matters of chance but are governed by definite laws. Specially what we recall is determined not merely by conscious association but also in large degree by unconscious or subconscious affective and voluntary processes.

In all of us there are innumerable deep rooted impulses, wishes and tendencies; some of them innate, others acquired; some of them conscious, more perhaps subconscious, repressed by education and convention, and yet capable of showing their force in unusual situations and especially when we are off our guard, as in plays and games, when, as is recognized by everyday psychology, one is likely to show one's real character. These are liable at any time to conflict with our conscious processes and to cause mental discord, confusion, or interference of association.

The outcome of Freud's study is to show the influence of the will and affective processes in recollection. The knowledge of this influence is not new, but Freud has shown how largely processes of will and feeling have an influence. This is most clearly and dramatically shown in pathological cases. If a person has been the victim of some shock or the like and had an experience repugnant to one's general character, this is likely to be thrust out of consciousness as much as possible, yet this repressed complex of memories remains like a foreign body in the mind, a thorn, not in the flesh but in the spirit, or a psychic lesion, as some psychiatrists call it. Such repressed memories may have a most disastrous effect upon the mental life, causing constant disturbance of the nervous and mental health, even when they have been so thoroughly repressed that the essential features of the experience have been forgotten by the individual. In all of us there are repressed complexes of ideas. Everyone has some skeleton in his mental closet.

The study by Freud (9, p. 131) of the psychology of everyday life emphasizes the uncertain line between the normal and the abnormal, and illustrates the way we are all

subject to interference of association. It makes this concrete and definite. The distinction between the normal and the abnormal is specially this: that in case of the normal the symptoms of interference of association and the like appear in the least important psychic processes, while all which is of great psychic value is free from interference. In the case of the abnormal they appear in the most important individual and social processes, so that they may disturb nutrition, one's professional work and social duties.

The singleness of mind, the unity and harmony of the mental processes extolled by Plato, has been the desire of intellectual men in all ages and the passion of the saint and the devotee. This has been the reward of the man of one idea, the crank, the reformer as such, the partisan, the fanatic. In extreme form this itself has become pathological; but in most cases of mental disorder, especially in innumerable borderline cases, the characteristic symptom is conflict. This condition is of course common both among the normal and the abnormal.

Among the usual forms of such conflict are cases where the individual finds his maturer beliefs in conflict with his early training, or where one finds nature in conflict with convention, and what one believes to be right and natural in conflict with the customs of society about him, or where one finds his public duties or occupation, his business, in conflict with the claims of friends and perhaps with the most sacred domestic duties; or again, where one finds his interests and passions in conflict with social ethics and morality. Innumerable cases are given in pathological literature.

In accordance with the law of inertia, as Lombroso might say, or as a result of this passion for unity of the mental life, the individual strives in all such cases to reduce the conflict (14), and this is done in different ways. Among the chief are the following:

1. One method of settling conflict is a decision in favor of one side or the other. This is normal, and the person with strong character will be able in this way to unify the mental life, or at least to reduce the interference of association from the conflicting aims and desires to a minimum. Once for all having taken sides and having renounced all conflicting aims and desires, the unity of the mental life grows more and more perfect and temptation grows weaker and weaker.

2. In case of those who have not the strength of character and the clearness of vision to make a decision in favor of one side or the other, the method most commonly adopted is probably that of repression. As most men dislike to make

decisions, conflicting claims and desires and ideals are repressed, thrust out of memory as much as possible. All of us resort to this method of repression in a vast number of distracting situations, and a certain amount of such repression we are able to endure. When, however, the repressed complexes of ideas are too strong for the given individual a pathological neurosis of some kind occurs.

3. When the conflict becomes unbearable between the repressed complexes and the normal stream of thought, the former are more and more dissociated from the latter, and in extreme cases the dissociated complexes may become a secondary personality.

Dr. Hart, in his excellent little primer on "The Psychology of Insanity" (14), maintains that conflict is a fundamental factor in the causation of insanity. The pathological mind has lost the homogeneity which is the ideal of normal personality, and has become disintegrated into more or less independent portions. But this disintegration invariably owes its existence to the presence of a conflict. The mind contains elements incompatible with each other, a dissociation has arisen as a method of avoiding the storm and stress of the warring elements. It is biologically a refuge, a protection, one of nature's methods of dealing with conflicts which seem insoluble. Dissociation, repression, and the like, are secondary results not primary causes.

Dissociation itself, however, is to a certain extent a normal protection against interference of association. All of us have certain more or less water-tight compartments in our minds, and while this may not be an ideal type of mind, the dissociation does often protect one from confusion. Dr. Hart illustrates this as follows (14, p. 57):

> "Although the phenomena just described are so bizarre, and so characteristically insane, yet this dissociation of the mind into logic-tight compartments is by no means confined to the population of the asylum. It is a common, and perhaps inevitable, occurrence in the psychology of every human being. Our political convictions are notoriously inaccessible to argument, and we preserve the traditional beliefs of our childhood in spite of the contradictory facts constantly presented by our experience. Such phenomena can only be explained by the existence of a certain amount of dissociation, and, though less in degree, it is precisely similar in kind to the dissociation which permits the asylum queen to scrub the ward floor, serenely unconscious of the incongruity between her exalted rank and her menial occupation."

These mental conflicts of the severer sort usually arise in connection with the great fundamental human instincts, especially with the social instincts. Freud has shown how largely

the sex instinct is involved, and Hart has called attention to what he calls the herd instinct, or what would better be called the group instinct; and he cites Trotter (26, 27), who has made a study of the sociological significance of this instinct. Hart suggests that the fundamental mechanism which underlies the vast group of insanities where individuals show unsocial tendencies, indifference to the ordinary conventions of society, and the like, consists essentially in a repression of this instinct.

The significance of these pathological cases lies in the fact that the abnormal merely represents in large letters and lurid colors what occurs in case of normal individuals. In all of us there is the same interference of association, the same desire for unity in the mental life. The more cultivated the individual, the wider the interests and activities of the individual, the greater the number of occasions for conflict and interference of association, and, so far as such conflict does occur, the greater the strain upon the mental health. Modern studies in psychology and psychiatry show not only the helpful methods of re-education in case of the pathological, but they suggest certain important preventives of interference of association and the conflict and confusion in the manifold distracting situations of life. In general terms these may be formulated as follows:

1. *An absorbing aim.*—The predominance in consciousness of some absorbing aim gives unity and coherence to our thinking. This was the essential part of Plato's doctrine of the hygiene of the mind (12) as I understand it. There must be unity, harmony, and coherence in the stream of thought; and lack of coherence, conflict of ideas, signifies loss, waste, lack of health.

Modern psychiatry has established this doctrine of Plato's in a most striking manner. Freud's doctrine of hysteria, for example, is that this nervous disease is due to a shock causing a psychic lesion, usually some shock in early life resulting in a complex of associations divorced from the dominant personality. This does not fuse with the ordinary stream of thought and acts like a foreign body in consciousness. Extending Plato's doctrine we may say that anything in a man's past that he dare not face, acts as such a foreign body and is detrimental to the mental health. Thus unity and coherence in the general stream of thought is the first essential condition for avoiding interference; and a dominant purpose goes far toward giving this.

2. *Interest.*—The child following some spontaneous interest is seldom the victim of interference. It is when dawdling over the uninteresting that his thinking becomes disorderly; especially if there is a strong emotional stimulus there is little danger of interference.

Freud thinks that no one would make a slip in speaking in the audience of the Emperor, or in a serious declaration of love, or in the defense of one's honor and name, and in short, in all cases where one's whole self is absorbed.

3. *Movement.*—The nature of the human mind is such that for continued interest, continued change is necessary. This is best expressed, perhaps, by the word "movement." This can be brought about by change in the external stimuli or by change in the subjective factor, the apperception of the individual. Thus, no matter how monotonous the environment, the man of culture can have a sustained interest because the richness of his apperception makes it possible to study the same object from many different points of view. On the other hand, the uneducated man keeps his mind clear and sane, in the routine of a monotonous existence by following the simple rule, *to keep moving.*

This need of change is recognized in our daily occupations; and in our hours of leisure and recreation, we are intolerant of monotony. The first essential of interest in a book, for example, is that it have movement. In fact, it is this need for change that causes the interference when occupied with a monotonous task.

4. *Activity.*—Co-ordinated motor activity is an important means of developing orderly association in general. In the various forms of manual work, and the like, close attention and clearness of the mental processes are essential, and practice makes for orderly thinking. Beyond all this, however, one's occupation represents perhaps the most important complex of associations in one's personality. If one has been fortunate enough to choose an occupation along the line of one's capacity, this becomes a focus for clear thinking and an anchor of sanity.

5. *Perspective.*—Another preventive of interference is what may be called mental perspective. One who gives attention to big things and is satisfied with essentials is far less likely to be the victim of interference than one who has an ideal of perfection in details. On account of the limitations of human nature one who tries to attend to all details is certain to suffer from interference and likely to neglect essentials.

The genius of the great man consists largely in seeing big things clearly and ignoring details, as was illustrated in the remarkable character of the late J. P. Morgan.

6. *Good physical condition.*—The dependence of orderly association on good physical condition is a matter of every-day observation. In abnormal nervous conditions, interference is a common phenomenon. The mistakes in the school, Bönhof has noted, are largely correlated with fatigue. The child speaks and reads and writes relatively smoothly in the morning, but toward noon makes many errors. Bönhof says that he himself makes slips in language most frequently after a long and fatiguing walk or the like. When one doesn't feel well one has a tendency to speech errors. Alcohol has a similar effect as a rule. In the school, the increase of such errors is a clear sign of fatigue and strain, or sometimes of momentary lack of adjustment. When such errors become common, the need of rest is indicated, and the natural reaction of a hearty laugh is a good remedy.

PRACTICAL SUGGESTIONS

What is the practical significance of all this for education? Is the demand for habits of orderly association really important? When one reflects how much can be done for those actually suffering from mental disorder by re-education and by developing habits of orderly association, one is forced to believe that a vast deal can be done by education in the way of prevention of pathological mental habits. The method that is good for cure is better still for prevention.

This condition of mental health, namely, orderly association, involves a fundamental and far-reaching principle. It should be considered in all arrangements of programs and subjects, in all methods of instruction. In school instruction, as the writer has pointed out elsewhere, there are not only the primary direct results of the teaching and the learning, but also certain secondary results, certain incidental habits developed, certain peculiarities of thought, certain mental attitudes, tricks of association, and the like. Some of these *should* be considered as primary aims of instruction and training, but as they are incidental results of the work, or usually so regarded, we may call them secondary results. With these, hygiene is especially concerned, and among these are the peculiarities of association often developed by the methods used. If we can prevent the development of habits of disorderly association, we shall do much for the mental health of the individual; for interference of association is often the germ of worry and the beginning of fear.

The aim of education is to make the new fuse with the old and become part of one's personality. Education would be easy if we had only to make sure that pupils learned a certain number of things in an ordinarily accurate manner; but the question of education is much more than this. It means the development of habits of attending to the essential and of ignoring the unessential, of orderly association in regard to at least a part of the field of human thought and experience, and the assimilation of what is learned.

It is one of the paradoxes of education that in order to remember we must associate an idea with many other ideas, but the larger the number of associated ideas the greater the danger of error. The following illustration from my own experience is typical:

Before I learned German I had no trouble in spelling the word school. But the other day I wrote the word *Schule* for it. I was writing English. I had no intention of writing German; but I was in haste. I gave attention merely to the beginning of the word *Sch.* If I had not studied German, but had specialized in English, the rest of the word would have come out all right; for the movements involved in making *sch* would have been firmly and clearly associated with those involved in making *ool.* But now the combination *sch* is associated in two series as the initial letters; and this makes error possible. If, as we may infer, we have here a typical illustration of what occurs in all such cases, then one of the essential conditions of recollection is a cause of interference and error.

It is precisely this fact, namely, that the greater the number of associations the greater the liability to error and interference, that makes mental hygiene necessary. In case of the uneducated person there is usually perhaps relatively little interference of association, except in regard to emotionally exciting events, but for the student or the man of affairs whose work makes manifold associations necessary, mental hygiene as regards association becomes essential, and in the school it is of prime importance.

Frequently in our experience this interference of association is not clearly conscious unless we introspect carefully. Dr. Gamble (11, p. 196) in her study of memorising by the reconstruction method, gives interesting illustrations. She writes:

"Proper names which have a certain arbitrariness and cannot be recalled by any process of logical memory, have sometimes a maddening fashion of slipping just beyond one's reach when most wanted, behavior which is probably due to the reciprocal inhibition of associations which run out from the ideas which ought to bring them

up. If one is asked, 'What did David say in his haste?' or 'What did Portia say about mercy?' one answers with mechanical glibness 'All men are liars' or 'The quality of mercy is not strained; it falleth like the gentle dew from Heaven'; but if one is asked '*Who* said in his haste, All men are liars?' or '*Who* said, The quality of mercy is not strained?' though one may answer promptly, 'David' or 'Portia,' yet the reproduction-reaction time will be a little longer, and one may be conscious of the swift mediation of other images—perhaps of an open Psalter or of a mediaeval court-room. One may even detect and suppress a conflicting association with the mercy-quotation; a New Testament scene or one or more of the Beatitudes may flash through one's mind, even when one seems to others scarcely to hesitate in giving the right answer. Now when proper names or syllables, which are still more senseless than proper names, are learned in order, no other association is likely to conflict with that which runs from the series-member to the idea of its number or place. On the "other hand, there are apt to be a number of conflicting associations with the association which runs from the number or place-on-the-list idea to the name or syllable, and even with the association which runs from one name or syllable to the next. For example, when one wishes to recall the name of the president who succeeded Andrew Jackson one's 'mind' may run feverishly about among the details of that gentleman's personal history or the actual consequences of his dictum 'To the victors belong the spoils' and may refuse—at least for the moment—to proceed along the straight line of the presidents."

The first guarantee of efficiency in recollection is the possession of habits of orderly association, and any method of learning is to be judged by considering its effect in producing or hindering such habits. Any method which loads the mind with unecessary material and that tends to develop a habit of attending to the unessential and of forming superficial or irrelevant associations is a distinctly bad one. Hence the danger connected with some of the mnemonic systems, the danger from pedantic methods of teaching, and from lack of perspective in learning. The waste of energy involved Watt (30) has well described as follows:

"A wrong association is very hard to eradicate. It introduces an element of competition into the working of the associations, and if a wrong association has become powerful enough to recall its word, the consequence will be that, in order to repress it, the correct association will have to be worked up to much beyond the strength necessary for the reproduction of its word, had no false and competing association been formed. To make the correct association compelling, it will have to be raised to that strength which will enable it to reproduce its word more quickly than the false association can reproduce its word. This means a great deal of useless and unnecessary labour."

The writer (5) has elsewhere attempted to show that time is necessary for the organization of impressions and associa-

tions. In cases of amnesia due to shock, or the like, where loss of memory extends only to a relatively short period preceding the cause of it, that is, in cases of so called retroactive amnesia, the amnesia may be due to the fact that the memory was never completely organized. In normal memory the process of organization is continually going on, and in order that ideas may become a part of the permanent memory, time must elapse for the organization or consolidation to be completed. Anything that interferes with this hinders acquisition.

Bergström and others have since found experimental evidence of this process of consolidation. Müller and Pilzecker, as already noted, found that in learning nonsense syllables less was retained if immediately after learning a series the observer was required to concentrate attention on some other task, and they assumed that the mental strain of the latter checked the consolidation process necessary for a permanent memory. This result strongly suggests also that interference of association occurred due to the task requiring attention.

That interference of association is especially likely to occur in the first few minutes after anything has been learned seems to be most strikingly illustrated by these experiments of Müller and Pilzecker. After learning a series of nonsense syllables by the method of paired associates they gave the observer a task requiring concentration of attention a few seconds after the learning of the original series was completed. Again in another series the task requiring attention was given six minutes after the original series was learned. A test was made of what was retained an hour and a half afterwards, and it was found that of the first series only 28 per cent was remembered; of the second series 49 per cent. In the case of the latter the process of organization or consolidation of the original series had been largely completed. In the first series there was not time for organization before the distraction was given, hence less was remembered, probably largely on account of the greater interference of association.

The practical bearing of this is obvious on a moment's reflection. Haste in learning defeats its own end, and a short rest may be frequently distinctly more advantageous than continued work. It is especially necessary that suitable periods of rest should occur between the learning of disparate topics. In the schoolroom, for example, from purely pedagogical reasons, not to mention hygiene, it is usually wise to give a rest of five or ten minutes, at least, after one

recitation or the study of one subject, before taking up a different one. The hurry from one topic to another in the ordinary class drill does not usually mean efficiency. Especially after the learning of a fact or principle of prime importance, a rest of a few minutes to give time for the organization of the memory may be a distinct advantage.

More recently Fräulein Heine (20) in G. E. Müller's laboratory has shown by experimental investigation that the mechanism of recognition and the mechanism of reproduction are different. Her experiments were in part as follows: The observers memorized nonsense material, then a distracting task was given, and after an interval a test was made, not of what was retained, but of what could be recognized. With the method of recognition there was no evidence of retroactive inhibition of the memory for the material learned. With the method of paired associates, the *Treffer-methode,* there was in all cases retroactive inhibition of the memory. This is a noteworthy result, and, although distinctly in conflict with what has been supposed to be the fact by some psychologists, seems to be well established by Heine's experiments. How shall we account for this? The obvious explanation seems to be that in case of the method of recognition there is no interference of association when the test of recognition is made; by any other method there is likely to be interference when the test is made. This is in agreement with general experience. We recognize hundreds of persons and things that we cannot recall by association, or recall with confusion.

The fact, which seems well established, that before the material learned has been thoroughly organized there is likely to be interference of association with all methods except the recognition method, and the further fact that when the new material has been thoroughly organized no interference is likely to occur, are distinctly significant for the hygiene and methodology of school work.

For a single illustration of the practical application of this principle take the methods of teaching any subject like a foreign language. In the early stages of learning, when error is certain to occur by the method of reproduction or the like, it is well to use largely the method of recognition. Familiarize the pupil with the different forms by showing them in the book and by repeating them; and do not attempt to have the pupil reproduce them until a considerable familiarity has been acquired. After a good degree of organization of the new forms has been gained, then a more effective method is the method of voluntary reproduction. Wherever

in fact the method of reproduction can be used without error it is distinctly better, but where error or interference of association is likely to occur, the method of recognition is better.

To illustrate more in detail the way the principles of instruction should be studied from the point of view of mental hygiene as well as from that of pedagogy in the narrower sense, take the subject of correlation. Few subjects have attracted the attention of teachers more than this during the past thirty years. Wherever teachers have gathered, and wherever educational periodicals have been read, the means of properly correlating the different subjects of instruction have been considered. But the problem of correlation is one of hygiene as well as of pedagogy. Many different subjects demand a place in the curriculum. It seems necessary that several branches should be pursued simultaneously. These subjects, however, must not be taught in a haphazard manner without relation to each other. Without correlation the numerous subjects of the modern programme are likely to cause confusion and over-pressure.

How may different subjects be taught simultaneously without confusion? One method is isolation. Dr. Harris has this in mind when he says in the Report of the Committee of Fifteen: "Your Committee would call attention in this connection to the importance of the pedagogical principle of analysis and isolation as preceding synthesis and correlation. There should be rigid isolation of the elements of each branch for the purpose of getting a clear conception of what is individual and peculiar in a special province of learning."

On the other hand, correlation is an important means of avoiding confusion. The demands of hygiene in regard to correlation result directly from the psychology of memory and association. To appreciate their significance we may again take illustrations from the psychology of memory.

Ebbinghaus (8) in his classic experiments upon memory found that after learning a series of nonsense syllables, although the memory of it was so evanescent that after twenty minutes he was unable to recall the series, still certain traces persisted unconsciously, so that even after a month the same series could be re-learned in less time than was required for a new one. We notice the same in ordinary experience. A forgotten poem or lesson is relearned more easily than an altogether new one. These unconsciously persisting elements we may suppose are entirely physical. They are simply the traces of neural habit; yet they are potentially related to consciousness, and are important.

Further the experiments by Bergström (3) have shown that such unconscious traces or rudimentary habits of association not only aid in re-learning an old series of associations; but that under certain conditions they hinder the acquisition of a new series. In one series of experiments Dr. Bergström tested distinction and choice times by having the subject of his experiments sort ordinary playing cards. Eighty cards were used in a pack, and there were ten kinds of cards, each marked by an abstract word printed at the top. The observer sorted these cards as rapidly as possible into ten piles corresponding to the ten kinds of cards, chance determining the order of the piles. Each experiment consisted in sorting two packs containing the same words into different piles. For example, one of the ten groups of cards, we will say, had the word *suggestion* printed at the top. In the first half of the experiment these cards perhaps were placed at the right, in the second half, in front of the observer. Another group was placed at the left perhaps at first, and at the right in the second half of the experiment, and so on. It was found that in sorting the second pack the time was longer and the observer seemed confused, showing a tendency to place the cards in the positions they had had in the first half of the experiment. Two different reactions were associated with the same sensory stimulus and interference resulted. Bergström's results do not, perhaps, show quite clearly how far the delay was due to these unconsciously persisting traces. But they do show, apparently, that during the process of acquiring such a series of associations, interference is likely to occur if different series are learned one after the other in immediate succession.

Experiments by other investigators indicate the same. On the other hand, experiments by Münsterberg in replacing old and well-organized habits—like the dipping of a pen in ink, the putting one's watch in a given pocket, and the like,—by new ones, showed that after the new series of motor associations was thoroughly learned, either the old or the new could function automatically with little interference from the other, i. e., there was no confusion.

The following will serve as an illustration: Dr. Münsterberg had an extended piece of work which required him to sit at his desk writing many hours each day. His custom, like that of most writers, was to dip his pen in an ink bottle placed at the right of his manuscript. He tried the following experiment: Two opaque ink bottles of just the same size and shape were used, one was placed at the right of his manuscript, the other at the left. The bottle at the right was empty, the one at the left was filled with ink. As he

wrote he automatically dipped his pen in the bottle at the right as usual, but getting no ink was reminded that he must try the bottle at the left. A record was made of every time the pen was dipped in the bottle at the right or a movement to do this was made. The result was substantially as follows: Twenty-five movements more or less to the right were made before the new habit of dipping the pen in the bottle at the left was fully established. Then the latter bottle was emptied, and the one at the right filled again. A number of movements towards the bottle at the left were made before the old habit of dipping the pen in the one at the right was re-established. Then the same experiment was repeated emptying the bottle at the right and filling again the one at the left. Some eight times the old movement of the hand towards the right was made before the new habit of dipping the pen in the bottle at the left was re-established. But the experiment was continued until, finally, the writer at will could change from one bottle to the other without making any false movements, that is, either habit could function automatically without interference from the other after a single initial impulse from the will.

These experiments supplement each other and they throw an important light upon the psychology of learning. The one series shows that there is likely to be interference of the incipient habits formed during a process of learning; the other indicates that after the paths of habit are well formed there is no interference. Of course, these experiments concern primarily the association of motor reactions with sensory stimuli; but the results are in harmony with those found in other experimental studies of memory, and illustrations from every-day experience might be given for other forms of association.

If, as we may suppose, we have here typical examples of what occurs in all psycho-physic associations, then a few pedagogical inferences seem legitimate.

It is clearly important in methods of instruction to avoid this interference of associations. Wherever a large number of subjects are crowded into the daily program, interference is liable to result. But it is necessary to have a number of subjects; for a child's attention cannot be kept long upon one thing. Interest soons flags. It is necessary both for psychological and hygienic, as well as for practical reasons, to have variety in the daily program. The psychology of association indicates the plan that is hygienic. Sometimes isolation is a means of avoiding interference, sometimes correlation.

The principle would seem to be as follows: When

the similar mental processes involved in learning two subjects are the essential thing, and when the differentiae and details are unimportant, correlation or concentration is advantageous. It is itself a means of avoiding interference of association. Similar processes are repeated in the different subjects, and we get the advantages of repetition without destroying interest. Thus arithmetic and algebra may advantageously be studied together; for similar processes in the two subjects are the essential things, and the differentiae are relatively unimportant. When, on the contrary, the dissimilar processes and the details are essential, isolation is advisable. For example, if one is learning two similar languages, say Italian and Spanish, for the practical purpose of speaking them, it is well to study one until the associations are well organized before taking up the other; for here the slight differences are important and interference of association would be likely to result if the two were learned simultaneously. Recrudescent memories of Spanish sounds might interfere with articulation in the Italian class; and Italian forms would be likely to be confused with Spanish. Of course, if these languages were studied for some other purpose, say for a general philological purpose, the reverse might be true. Cognate forms would naturally be studied together. Thus where the dissimilar elements and processes are essential there should be isolation rather than correlation. For example, the correlation of arithmetic and religion, frequently attempted in the past, would seem to be unwise.

This principle concerns not merely the matter of correlation in the program; it should be regarded also in the more concrete questions of method.

A great many concrete educational problems come here. What is already known throws light upon some of them. Where two series are to be learned, several members of which are common, as h b c i f and h b e i l, should they be learned together or separately? The answer to this, as already pointed out, depends upon the purpose for which the two series are learned. If they are learned together, there should be a large number of repetitions to insure the permanency of correct associations. Usually it would seem to be better to study the two series separately at first until they are pretty firmly impressed upon the mind, because there is likely to be interference of association, if not actual error, when the two are studied simultaneously. Take a single concrete example; one of the chief difficulties in orthography is the spelling of homonyms and the like,—similar words, such as the verb *advise* and the noun *advice—council,* the

name of a deliberative body, and the *counsel* of wise men to which we are supposed to listen. Many are here the victims of chronic interference of association. According to our formula, the spelling of such words should in the first instance be taught separately with many repetitions, not simultaneously as is often done; for here the differentiae are essential. Such a problem, however, must be solved by experiment. In this particular case the problem has been studied experimentally by Pearson (23); and while, it is true, his results indicated that fewer errors occur when homonyms are studied together, apparently he did not determine in how many cases the students tested by him had already mastered one member of the pairs studied; and recent experiments by Finkenbinder, not yet published, indicate that so far as experiment is concerned, this problem is at least still open.

So much for the hygienic aspects of correlation. I may be more or less right in the way I have formulated the practical principle stated; but the general principle is clear enough. The aim in correlation should be to avoid interference of association as much as possible. The hygienic importance of this is obvious when we recall that usually confusion is a form of worry.

Of course, careful thinkers often come to practically this same conclusion when they aim to correlate according to the natural relations of things; but the point to be emphasized is that the practical pedagogical problems of correlation and the like should be studied from the point of view of hygiene and the psychology of association as well as by the more strictly pedagogical method usually adopted. This would not only be of advantage hygienically, for avoiding confusion and worry, but it would also check the abuses of correlation that its most ardent advocates deprecate.

In the organization of the curriculum, the articulation of the grades, and the like, as well as in the concrete methods of instruction, this principle of orderly association should be regarded. As a matter of fact it has often been strangely ignored in the schools; but here and there an experiment has been tried by a method of concentration in accordance with sound principles. At Frankfurt, in Germany, for example, such a plan has been adopted for many years in the teaching of foreign languages in the secondary schools.

For example, in the Gymnasium in Frankfurt, French takes the place of Latin in Sexta, the first year of the course, and no other language is given for the first three years; thus the pupils concentrate on this language until its forms are pretty thoroughly organized. Then at the beginning of Unter-

Tertia, the fourth year of the course, when pupils are perhaps twelve years of age, the study of Latin is begun. French is continued; but with the thorough organization already acquired there is little danger of interference of association; and the larger part of the time is devoted to Latin, some five to ten hours a week. Then after two years more, when the Latin forms are thoroughly organized, i. e., at the beginning of Unter-Sekunda, when pupils are perhaps fourteen years of age, Greek is begun. Latin and French are continued; but their forms are so thoroughly organized that it is possible to take up a third language without much danger of interference.

Whenever new subjects are taken up it would seem wise that there should be concentration on a single subject for a sufficient length of time for thorough organization of the essential forms, and that related subjects should not be begun until the organization is sufficiently far advanced to hinder interference of association.

In all methods of learning the same principles should be remembered. In committing to memory, for example, the whole method is better than the part method, not only because the task is usually learned more quickly by the whole method, but also because with the whole method there is less occasion for interference of association. Thus in learning a stanza of poetry it is an advantage to learn it as a whole. With the ordinary method of learning by lines an interfering association is liable to be formed between the end of a line and the beginning of the same line.

In most errors, such as are made in the school room, there is interference of association. On the other hand, that errors are likely to cause interference of association has been shown by convincing evidence. Culler, for example, reports the results of his own experiments as follows:

"The records as well as the introspections show that one error tends to cause another. This is what Book means when he speaks of 'bad associations,' 'bad tendencies' and 'interfering habits.' Errors are not grouped by mere chance, but an error makes an interfering association which is hard to overcome. The cause of the grouping of errors is due to these bad and interfering associations. Bosk finds that in some cases it takes a very long period of time for them to drop out, and that not until they do drop out can there be unimpeded progress. He cites the case of a music teacher who recommends that in learning to play a piano, it is better to practise in periods of 15 minutes with recesses, than to continue for an extended practise, because of the fact that interfering tendencies do come in and cause error. When these drop out again gain can be made without the strain and useless labor that would be expended in a long practise at the time. This accounts for the little improvement on some days and the smooth progress made on other days."

The desirability of helping pupils beforehand on the lesson of the following day is obvious. Right forms and correct methods can be emphasized and error avoided. In all forms of motor training, including reading and speaking, it is especially important to avoid error; and unless in the first instance the teacher goes over the lesson with the pupil, mistakes are almost sure to occur. In many schools it is the custom to give special drill at the end of the recitation on the work of the succeeding lesson, in order that the pupils may in their study by themselves drill on correct forms. In general the aim should be to avoid error rather than to correct it. In questioning there is special need of considering the formation of habits of orderly association. Ordinary methods of questioning are apt to lead to interference. A question is an association experiment under school conditions; an association experiment is a question under laboratory conditions. The child's association reaction-time is very much longer than that of an adult; hence, as Mr. Yamada (31) has shown, it is especially necessary to give time for children to answer; and, as Meumann has found, quick answers are apt to be senseless answers. Again the spontaneous report, the *Bericht,* is in most instances probably less likely to cause interference of association than ordinary questions, because a child has the opportunity in the *Bericht* to express dominant ideas first, and this often saves interference.

Again in the ordinary questioning of the classroom it is well to remember that where children are especially interested in one special point, as is often the case, it is wise to let them express themselves on the topic on which they are interested and get it off their minds wherever it is possible, otherwise interference of association is almost sure to occur. It is true that pupils should be trained to give attention to the present situation; but when they come into the schoolroom their interest in the previous present situation is often so great that until they have fully expressed themselves upon that it is impossible for them to concentrate on the new situation. By all means they should be trained to attention to the present, but a psychological method should be employed in developing such attention.

Recent studies, especially experimental investigations of the higher thought processes, have shown how important are the instructions given by the experimenter, in determining the attitude and associations of the observer. Under certain conditions, for example, positive instructions make for unity and clearness, negative instructions tend to produce interference of association. Geissler in his experiments found evi-

dence "that a simple positive instruction sets up only one determining tendency, in accordance with which certain mental processes are neurally prepared for easier and quicker entry into consciousness as soon as the proper stimulus occurs; while a negative instruction sets up at least two determining tendencies, which either bring about a more or less conscious conflict of two mutually exclusive motor reactions, as in the attitudinal form of suppression, or prevent their ideational representations from issuing in motor discharge, and thus allow another neurally prepared process to lead to a reaction, as occurs in the ideational form of suppression."

Whenever students come to a recitation with a wrong attitude there is sure to be interference of association. Of course this may be an attitude of repugnance to the subject, or dissatisfaction with the method employed, or dislike of the teacher, or a critical attitude, or an attitude of indifference, or what not, but in any case it is likely to cause confusion. This is often seen even in the case of mature students. For a single concrete illustration, the writer has often seen students at the doctor's examination unable to answer some simple question because their attitude was one of adjustment to a very difficult situation, and expecting an extremely difficult question they were quite unable to apperceive and answer a very simple one.

At the ordinary school examination one finds many illustrations of interference of association. The necessity of finishing one's work in a given time, the importance of answering as well as possible, the fear of failure, and the like, all are liable to produce interference and confusion. The ordinary attitudes of the examination make interference almost inevitable, and the experience of many a student is similar to that reported by Mr. Yamada (31, p. 179), who says that in his own case a question at an examination or the like "causes a sudden arrest of psychic activity, or there arises out of unconscious complexes an apparently unrelated idea."

Finally, it should be remembered that the attention of children is not as easily adjusted to a new situation as that of adults. More time is required for them to turn attention from one thing to another. Until they are able to adjust attention to the new, interference is liable to occur, and both in discipline and in instruction allowance should be made for this slower process of adjustment in case of children.

Dr. Rosanoff and Miss Rosanoff (24) have made a study of association in children. The material consisted of 300 records of association tests made on as many school children between the ages of 4 and 15, the subjects being selected at random, although an equal number of each age were tested.

The results showed that the younger subjects gave a comparatively large proportion of doubtful and individual reactions and failures to react, with a corresponding reduction of common reactions. The authors conclude that the tendency of children to respond with individual reactions more often than adults were due largely to lack of mobility of attention, which results in an inability quickly to dismiss from the mind the previous stimulus or reaction words, and to turn the mind wholly toward the new stimulus.

These authors found also a definite correlation between association and mental capacity, and also between association and school grade. Extreme departures from the average at a given age they conclude are dependent on pathological variations in mental capacity, plus variations being characteristic of unusual precocity, minus variations bordering on the pathological.

In the school room the phenomena of interference of association are very common. They appear in a great variety of forms from mispronunciations and errors in motor adjustment, mistakes in spelling, and the like, up to the extreme forms of distraction and worry on the border line of the pathological. Bönhof (4), for example, has pointed out how frequently mispronunciations occur in the schoolroom. Not an hour, he says, passes without the teacher or pupil makes such mistakes. Almost everybody makes them; children and adults; cultured and uncultured; rural and urban children alike. The teacher can learn much from such phenomena; and on his part he can do much to eliminate them.

Thus in all methods and subjects the principles of orderly association should be considered. If there were time, concrete illustrations from the different school subjects could be given; this whole matter is really so fundamental in the hygiene of instruction that all methods of learning and of teaching should be judged by their value in producing orderly habits of association. And any method or device, or sequence of subjects, or the like, which is likely to cause interference of association is looked upon with suspicion from the point of view of mental hygiene.

If, perchance, these suggestions seem to the reader remote from practical hygiene, let him recall that interference of association, error, and confusion, usually mean the beginning of worry—the great enemy of mental health,—and that positive hygiene prefers the development of healthful habits of mental activity in the school to re-education in the sanitarium.

SUMMARY

1. Interference of association is inevitable on account of the fact that simultaneous stimuli of the nervous system may conflict and be more or less mutually inhibitory.

2. In highly organized individuals capable of mental work, interference should be exceptional and not continuous. It means great waste of energy, and when habitual is liable to be the cause of nervous disturbance.

3. It is of fundamental importance for the healthful development of the nervous system and for pedagogical efficiency to avoid interference of association as much as possible in all forms of school work, not only by methods of instruction and of learning, but also by the arrangement of programs and the like.

4. In arranging the program, the practical rule should be: Where the similar processes in two subjects are the essential ones, then correlation is advantageous. It is a means of avoiding interference of association. On the other hand, if the differentiae and details are the essential things, then isolation of the two subjects is advantageous as a means of avoiding interference of association.

5. Time must be given for the organization or consolidation of what has been learned. Interference of association is most likely to occur in the first few minutes after the acquisition. Thus it is of practical importance at the close of a period of study in one subject or after the learning of a specially important fact or principle to give a few minutes for rest. A recess of five or ten minutes may be more important for the fixing of what has been learned than continuous study. The constitution and character of the nervous system make the need of time for organization imperative. Haste defeats its own end.

6. The secondary results of school instruction referred to are of primary importance for hygiene; and many of the so-called secondary results are also of prime importance for pedagogy.

7. The development of habits of attention and orderly association is quite as important for the prevention, as re-education, for the cure of nervous and mental defects.

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PHYSICAL TRAINING IN THE NORMAL SCHOOL

By Henry S. Curtis

A normal school is a place of training in the art of teaching. The subjects that are required there are supposed to be selected on the ground that they will be directly useful to the teacher later. This consideration, however, has not applied to the work in physical training. There has apparently been no attempt to select physical activities that the teacher could use with her students. In general in this country we have not required physical training in a systematic way until the high school or college is reached. This is the more remarkable as it is obviously the inversing of nature's method. The child is born a little animal. His first interests and achievements are almost entirely physical. The physical period is the period up to puberty. After that there is a great awakening of the intellectual and emotional nature. The child rises into his last inheritance of civilization. Never afterward is the child estimated among his peers so largely by his prowess as he is in the years up to twelve or thirteen, and this of course means that never at any other time is physical prowess so much desired or so interesting. The little child spends nearly all of the energy that he develops in motor activity. Witness the ceaseless running back and forth of the three-year-old or the child of five. In my own studies of the activity of children at Clark University, using American pedometers, I found that where the daily activity of the school children was only eight and five-sixth miles, the activity of the children from three to six years of age was nine and two-fifths miles, showing about a half a mile greater activity on the part of the little children. Again, while the average activity of the school children was only eight and five-sixths miles, their activity on Saturday was ten and a half miles, showing again how much the school was repressing their normal activity. The little children who did not like to go to school usually gave as the reason, because "they had to sit still." Repeated tests showed that the little children less than six years old could not sit entirely still for more than thirty seconds; that when they were required to sit still for a considerable time, they became restless and irritable. This restlessness is only the outward expression of the high nervous pressure that comes from motor energy unused. The asso-

ciation fibers in the child's brain are poorly developed, he has to use the energy of each motor area largely in its own particular muscles, which can only mean that to avoid restlessness the small child must use all his muscles frequently. It is needless to say that this everywhere agrees with common experience.

Everything seems to say that the time for physical training is in the elementary school. It is then that there is the greatest interest in physical achievement. Health and life itself are dependent upon establishing a strong physique at that time. Physical development in childhood builds the foundations on which all later achievements must be erected. If the child is anemic and puny, he is likely to be carried off by sickness. He can not stand the worries and labors of school life. As soon as puberty comes the girl puts on her long dress, and her physical activity is greatly limited thereby and by the periods of disability that come with it. She must get most of her physical training, if it is to be really a general training, before this period. In the days of Pericles, the boy up to fourteen years of age went to the playground in the morning, and to the school in the afternoon. In Germany to-day there are three hours of physical training a week in all grades of the elementary school. In the English schools that prepare for the public schools, such as Eaton and Rugby, there are about fifteen hours a week. In contrast to this we have scarcely any in the elementary schools of this country. There is, however, a strong movement in this direction at present. State requirements are being established, and curriculums of games are being introduced. The time to train along any line is surely the time of greatest interest in this activity and the ripening of the faculty which controls it. The intellectual development of the race has followed its physical development. The physical is the first side of the individual to come to maturity. All of these arrows indicate that physical training should in general precede intellectual training, and should be completed long before the intellectual training can be finished. The physical training of the child begins in the spontaneous movements even before birth. The baby lies upon his back, and kicks up his heels, and waves his fists in such a way as to give almost ideal development to the muscles of the arms, legs, and back. The child of two or three finds in running and walking and climbing constant use for every muscle. In pioneer days this training was naturally continued by the hunting, and the fishing, the felling of trees, and the other activities of the frontier. To-day for the great majority of children these activities have ceased. The daily

life no longer furnishes the necessary exercise, and the school must do it.

If this standpoint be true, and physical not intellectual training is the paramount need of little children, then it follows that the physical training of the normal school must be normal training, the same as in other subjects presented there; that the teacher must not come to the school prepared to give a certain quota of information alone, but she must be a good physical type, able to do the physical stunts as well as the mental ones. We must get away from the ideal of the teacher as a lean ascetic poring over some dusty volume in the small hours of the night, and see in its place the healthy, robust, wholesome man or women, with large sympathies and large acquaintance with life, who comes to live with the children for a season. His main business is not to teach arithmetic or geography, but rather to train individuals on every side of their nature. He will teach arithmetic, but he will also teach baseball. He will see that the relationships of the children to each other and the spirit of helpfulness and friendliness which they develop are quite as important as anything that he can teach them, and he will not seek so to monopolize the child's time with the set subjects of the curriculum that there will be no time to be a child and gain the experience of a child. If the normal school is to make its physical training also normal training, then it must obviously select physical activities that can be carried from the normal into the public schools.

Gymnastics.—To most people physical training means gymnastics and a gymnasium, but it must be seen at once that no system of training that requires a gymnasium or an expensive equipment to carry it on can be either normal or a practical training for our schools at present, for the reason that far less than one per cent of them are provided with gymnasiums, and the teachers can not carry a gymnasium about with them. There probably is not more than one per cent of the normal students for whom heavy gymnastics may offer real normal training. Light gymnastics with wands, Indian clubs, and dumb-bells, are more practical in that there are far more schools provided with these facilities than have gymnasiums. But it must be said of these exercises in general, that they do not give fresh air, and that they offer very little if any mental relaxation or recreation. Calisthenics can be carried into any school, as no apparatus is needed, but the same criticisms hold true of them as of the light gymnastics. In general practice also they are given in a listless,

spiritless way that means neither physical training, fresh air, or recreation.

Athletics.—Athletics as they exist at present in our normal schools make no better showing. The whole tendency in athletic reform is to provide athletics for the student body and get away from the intercollegiate type of sport. Yet most or at least many of our normal schools have no other sort of athletics, and the whole effort apparently is to get a winning team that can scoop any other school in the neighborhood. I doubt if a normal school should have any competitive athletics at all. Certainly such practice is not normal training, and it tends to perpetuate athletics of this type in the schools of the country. As physical training for the student body, it may be disregarded, because it reaches so few. The only athletics pursued by the girls in most normal schools is tennis and a little basket ball and hockey. While the young women probably constitute four-fifths of the students, the entire athletic field is usually given over to the young men and competitive sports, and the young women have to play in such space as they can find.

General Athletics.—Athletics in this country have been subject to two general criticisms. They have reached only a small per cent of the student body, and in general the strongest and best developed part of it, who had the least need of the training; and second, there have been no standards. The A. A. U. has had almost absolute control of our athletics, and under the guise of promoting amateur athletics has been interested only in the specialist in sport, who has been practically a professional whether he has been paid for it or not. It has not been interested in general educational athletics for the student body. The sort of sportsmanship and courtesy that has been shown at our great college games often has been a denial of all the social and moral standards of our civilization. The movement for reform in athletics has also two essential directions. Seeing in athletics a valuable physical, social, and mental training, it demands that it should be provided for all, and that it should be recognized as one of the great educational forces of the country. The reformers are unwilling to let our standards be set entirely by the sellers of athletic goods or by semi-illiterate coaches who are hired to win games.

Dr. Luther Gulick has probably done more to reform athletics in this country than any other one man through two methods which he introduced into the public school system of New York, and has since promoted about the country.

The first was the forming of the Public School League of New York City, which is similar to the Schools Athletic League of London, but was probably a new invention with Dr. Gulick. The essential contribution of this League has been the introduction of a non-competitive standard test, which sets boys to competing not against each other but against a standard accomplishment which any well developed boy should be able to perform. In competitive athletics, children soon learn their relative place. It becomes perfectly certain that Johnnie Jones can beat everybody else in the hundred yards, and consequently no one else cares to run. Competition amongst individuals tends to the selection of a few winners, toward the specialization of the most capable. This is not the kind of training that the school should give. The small child needs not specialization but general training; and all, not a few, should get the benefits. The Public School Athletic League issues a handbook which sells for ten cents and contains its standards. The secretaries of this league are paid by the Board of Education in New York City. There are about a hundred other cities that have taken up these standards adopted by New York City. The common standard is that the boy under thirteen shall be able to run the sixty-yard dash in eight and three-fifths seconds; jump five feet nine inches standing; and chin a bar four times. These tests have two great advantages, that they get a large number of pupils into training, and that they set a standard of accomplishment. At the time we first tried this test in the Washington playgrounds, we found that there were none of the children able to do the three things; but after four summers of organized play, over five hundred children did the three things. Children always tend to come up to a standard. These tests do not require much room. If there is not room in the school yard, the children can run the sixty-yard dash in the street. This offers practical athletics for all schools whether city schools or country schools. All normal students should have some practise in trying or at least seeing these tests. They may be difficult for women students in a normal school, but if boys are to be taught by women, the women must have some of the accomplishments of the other sex as well. At least they should understand what these accomplishments are and how they are acquired.

Class Athletics.—The other form of athletics promoted by Dr. Gulick which is suited for use, is the type which is known as class athletics. Class athletics were invented by Dr. Ballard, assistant director of physical training for New

York City. In class athletics the class competes as a unit and the average record of the members of the class constitutes its record. At least eighty per cent of the class must compete. As the class record is largely determined by the accomplishment of its weaker members, this sets all the class to train these weak ones. The competitions are usually in the same event as the standard test. In some ways it is simpler in practice than the individual test, as the record of forty boys can be taken in a dash without a stop watch. If it takes the class five minutes and twenty seconds to run the distance, simple division by forty will show that the average time was eight seconds. The average records that some classes have made in this way are truly astonishing.

Relay Races.—There is an almost infinite variety of relay races, nearly all of which are interesting to children. Where there are a large number of children in the relay, this is one of the easiest ways to interest children in running, and the wildest enthusiasm is sure to result.

Folk Dancing.—There is a great new interest in folk dancing at present, also largely due to Dr. Gulick. The folk dances are the old racial dances that have been practised by peasant peoples in the market places or on the green for generations. They are nearly all vigorous, offering the best sort of physical training. They are done to music thus adding the charm of rhythm. They are too vigorous to be suggestive and leave the dancer too tired to concoct mischief. For the most part, the women dance with the women and the men with the men. They are one of the best antidotes we have for the dance hall with its well known evils. They are being introduced into the public schools quite generally about the country. In certain places there will be prejudice against them, because of the name, but there will be little if any prejudice arising from the exercise itself, and the prejudice is rapidly disappearing. The great obstacle in the way of their general introduction in the past has been the impossibility of securing suitable music. This has now been overcome through the Victrola machine and records, as a Victrola with ten records can be secured for a little over fifty dollars, which surely is not a prohibitive price for any school. Folk dances lend themselves peculiarly to festival occasions where they usually form one of the chief charms. These festivals are spreading to the small towns and the country, and the ability to get up an acceptable play festival will be sure to increase the popularity of the teacher in the community. Folk dances have the advantage of giving both

physical exercise and grace. While they are ordinarily learned in a gymnasium and thus are not directly in the open air, they may be learned in the yard instead and are often practiced there. Folk dancing is especially adapted to the physical training of girls, from the fourth grade on; and all women students in the normal schools should be required to learn a few of the simplest ones.

Volley Ball.—In regard to games for older children, until very lately our schools have been facing almost unsurmountable difficulties. The school yards have been very small, and our national games have been baseball and football, both of which required very large grounds. The games and the yards could not come together. The renaissance of play has brought with it several new games that are suited to the space as the others were not. Among these games is, I should say, first and foremost, volley ball. Volley ball is a natural corrective of the stooped and rounded shoulders and the hollow chest of the class room. It ought to be required in the upper grades if for that reason alone. It demands very little space, as the ground is only fifty by twenty-five feet in size. The ball is soft and does not break the windows. The equipment is very inexpensive, costing not more than five or six dollars for the complete outfit. The game is played by girls as well as boys; but perhaps its greatest advantage is that children will begin to play it at nine or ten and continue to play it until they are sixty or seventy. It is peculiarly fitted for the rural school, because the boys may play with or against the girls, and it is often the only team game that there are enough of the older children to play. It is especially adapted for school use, because there may be any number of players on a side, and the class may take the game as a regular period of physical training. It is almost the only game that can do the work of corrective gymnastics. Every girl ought to play the game in order to get her head and shoulders back and stretch her chest out. Every country boy ought to play the game if it were only to cure his round shoulders and forward slanting head. Volley ball is being systematically introduced in a number of city school systems at the present time.

Indoor Baseball or Playground Ball.—Playground baseball is played with an indoor baseball on a thirty-five foot diamond. It is like regular baseball, except that the ball must be pitched underhanded, and the player is not allowed to steal bases. It is equally well adapted to the play of girls and boys. In Houston, Texas, I found there were from three

to five teams among the girls in every school in the city. A diamond can be laid out in almost any school yard. It is a really practical game for the school and the city.

Long Ball.—Long ball is a variation of indoor baseball, but it is played with only one base, which corresponds to second base. The player is put out by a caught fly or by touching or striking him with the ball as he runs. There are no fouls, and any touch of the ball is a fair hit. There may be any number of players on a side. The game is very fast, because of the absence of fouls.

Basket Ball.—Basket ball is the game most commonly played at present in school yards by older children. Nevertheless it does not seem to me to be as well adapted to their needs as the games that I have mentioned. It is not played much by children before they are thirteen years of age. Girls and boys play by different rules, so that they can not play together. In the country schools there are seldom enough older girls or boys to play the game. Basket ball makes the most violent strain on the heart of any game that we know, because the playing is almost continuous. The strain is much greater than it is in football. If the game is to be played in the elementary schools where the pupils have not been examined, the halves should be not more than ten minutes. Basket ball has the element of personal encounter in it, which is apt to lead to rough play and quarrels. A class can not well be taken out to play basket ball, as there will always be a number who are not strong enough to play the game, and only ten players are required. This would make four grounds necessary to have a class of forty play as a regular exercise, and most school grounds do not have that much space, as the ground 35 x 70 is nearly twice as large as the volley ball ground.

Tether Ball.—Tether ball is well adapted to school yards. It is the most vigorous game that we have that can be played on a small space. A pole thirteen feet in length is set three feet in the ground. On the top of the pole is a tennis ball in a netting sack. A ring six feet in diameter is drawn around the pole, and a line twenty feet long bisects the pole and the ring. One player stands on the one side with a tennis racket and drives the ball around the pole as hard as he can, and his opponent drives it back again. The one who succeeds in winding up the ball around the pole above the black line will win the game.

Captain Ball and Emperor Ball and Newcomb.—These are games well adapted to school use also. They are games of lower organization and serve as a good introduction to the other games.

Tennis, Hockey, Baseball and Football.—Every young man ought to be able to play all of these games fairly well, and every young woman should be able to play the first two at least. Nevertheless they can not be properly normal subjects, because there is not room for them on the school yards ordinarily.

Class Room Games.—There have grown up during the last few years a series of games suitable for any classroom. These may be played in place of having recess on a rainy or disagreeable day or to liven up the class whenever it gets dull. They are carried on between the desks or over them and are practical for any school. If the windows are thrown open during the period, such games may meet the requirements of exercise, recreation and fresh air. Such games are just as truly normal subjects as arithmetic.

Games for Little Children in the Yard.—By these I mean the current games for little children, such as can be found in Miss Bancroft's book of Games or in Johnson's "Education by Plays and Games." These games the teacher may everywhere use voluntarily, at present, and they are therefore directly practical. But a normal school should be prophetic. It is training not for to-day or to-morrow, but the students of to-day must be trained along the line of educational progress and fitted to lead the movement. They should be prepared for conditions which are to prevail five or ten years hence. All the indications seem to show that the time is not far hence when we shall require the teachers to organize the play of the children. This has already come in Germany and Denmark and England, and I know not what other countries. Most of our progressive cities now have organized recesses for the younger children, and in a considerable number of cities, games are being introduced into the curriculum, and are taking certain periods previously devoted to class work. Even if games are not required, the teacher ought to play with the children in order to get in sympathetic touch with them and be able to understand them.

Physical Training in the Elementary School.—I am inclined to think that inasmuch as the early days of life are the physical period, that not less than half of the time of the lower grades and perhaps of the entire elementary school years should be given to physical training, and that this amount

should be decreased gradually as we go up into the high school and college. That the time for the majority of the physical trainng is in the elementary school period, seems to be scarcely open to dispute. But play is also the life of the child, in which he is forming most of his habits and gaining nearly all his experience. There is a large mass of facts that seem to indicate that the elementary children would make quite as good progress in their studies if a half of their present school hours were devoted to play, and they would be acquiring at the same time other forms of training that would be worth quite as much to them.

Rules for Games.—Anyone who will study the athletic guide for any of our games will soon be convinced that these rules were intended for professional players and not for children. The rules presuppose the professional umpire and the grandstand full of spectators. In Germany the Association for the Promotion of Folk and Child Play has issued several hundred thousands of books of rules for the common games of the children. It seems to me little less than a national disgrace that we have left the athletic supply houses to make the rules of our children's games. These rules are too complicated in the first place, so that school children can not understand them. In the second place they are not designed in general to secure social and educational results but a spectacle. Is it anything less than a scandal for instance that the only book of rules that we have for volley ball, makes it one of the conditions of playing the game that "The Spalding Official Ball shall be used." One can but ask himself: Do our American games belong to the supply houses?

Will the Games and Dances Give Physical Development?—People are not accustomed to think of games as a system of physical training, and most people would be inclined to question whether or not it would be possible to secure adequate physical development in that way. Games will not certainly produce the type of the Farnese Hercules, but they may well create the type of the Apollo Belvidere. They will develop a strong heart and lungs and a stable nervous system; they will produce strength of legs and body muscles; but they probably will not secure to any large degree strength of arms. The child uses constantly in his play nearly every muscle in his body; and if these games are only interesting enough and are carried on for a long enough time each day to lead to a maximum of effort, they furnish almost ideal muscular exercise. Gymnastics seldom reach all the muscles in the same way that the child uses them in his play.

MENTAL DIFFERENCES BETWEEN THE SEXES.

One of the most extensive and well organized series of experiments for the exclusive purpose of discovering whether there are mental sex differences and what their nature may be, is reported in the June and December numbers of the *Journal of Experimental Pedagogy* for 1912. In this somewhat lengthy article of forty-seven pages, the authors, Burt and Moore, have ably correlated their results with those of other investigators in the same field. The introduction of well-planned graphs serves forcibly to illustrate the points involved. Whatever conclusions one may draw from the experiments, one can not but wish for more of the same character and quality, in this and kindred lines.

Perhaps the most popular way of comparing sex differences is by contrasting conspicuous characters in particular lines. For example, Ellis says of the 1,030 persons of eminence in British history but 55 are women. Cattell, out of the 1,000 most prominent persons in the history of the world, finds but 32 women, and these prominent because of beauty or birth. There are said to be nearly twice as many men as women in the asylums for idiots and imbeciles. Any conclusions from such data, as the authors have most forcibly shown by well plotted graphs, can have but little significance. The extreme is no indication of the mean. For the general tendencies of the two groups may run practically parallel.

The chief theories for sex difference have been biological, and the distinction of sex has been largely with reference to reproduction. The authors think that conjugation seems necessary for the perpetuation of the species, but it should be said the experiments of Woodruff contradict this assumption. Those qualities connected with reproduction are called primary, all others, such as height, voice, strength and, it is generally thought, mind, are called secondary. The ultimate origin of the latter is a matter of much controversy. The explanations may be grouped in five sets of theories of which the key words are,—selection, development, constitution, environment, transmission.

Of the first, Darwin has given probably the best and most complete discussion. This group of theories, however, fails to explain why the secondary characters of each sex are transmitted to each particular sex,—why they do not blend in equal proportion.

The developmental theories claim that the inequality of the development of the primary qualities produces the large secondary sex-differences. Spencer calls woman "an arrested man" and says she "remains more of a child and something of a savage." This being true, our education should be entirely different for the sexes.

Advocates of the constitutional theories tell us that the sexes are the natural antithesis but necessary correlatives of each other. This difference pervades the whole organism. The spermatazoon is small, active, katabolic, while the ovum is large, inert and anabolic: the male is usually smaller, more active, enterprising and prodigal in structure; the female is larger, passive, submissive and economical. Man therefore, is progressive, egotistic, self-regarding, rational, inventive, while woman is conservative, altruistic, species-regarding, emotional, and receptive. Then our education of the sexes should be entirely separate.

In regard to environment, "the outcome of this study" (an investigation into the mental differences of the sexes), says Helen B. Thompson in her excellent work, "is that the psychological differences of sex seem to be largely due to differences in the social influences brought to bear on the developing individual from early infancy to adult years." Such is the position of the environmentalists.

Of the transmission theories little need be said; for the preponderance of biological evidence is against the idea of acquired characteristics.

In the determination of mental sex differences, the authors think the following are the crucial questions to be answered: Are the mental differences greater than the physical differences? Are the mental differences greater upon the higher levels of conscious life or not?

From the Junior Form at the Wallasey Higher Elementary School, at which the forms are based on age, 130 children, 67 boys and 63 girls, were used in the experiment. These children formed two comparable and homogeneous groups. They were from 12½ to 13½ years of age. This age was taken because younger children were not desirable for some of the tests, older children would be more differentiated by puberty, sex differences in degree of general development appear minimal, and the weight, actual and relative, is about the same. The tests were made between Feb. 1911 and March 1912. To offset the probable advantage of the girls at this age, some of the tests were applied to children from 9 to 10 years old. Most of the tests were also tried on adults.

The authors first tested sense-perception, or the simple perceptual processes, comparing their results with those obtained by Miss Thompson and those obtained from Aigburth and Oxford children.

In the "spatial thresholds," they found females nearly twice as acute as males. For pain proper, women appear more sensitive, but in ability to endure deep-seated pain or painful or unpleasant experiences, men excel. In the "muscle sense" men are more acute than women. Using Miss Thompson's data for taste and smell, women are found to excel men in ability to recognize the presence and nature of tastes and odors,—men are more acute in the discrimination of the qualities of tastes and odors. Thus men are used for tea-tasting, wine-sampling, etc.; for this work depends upon a low relative threshold. In the discrimination of pitch and color, girls and women excel boys and men. In judging length of lines, area, brightness, recognition of dim light, and of spots according to size and distance, boys and men are superior.

From these data, the authors conclude that the "differences are of such a nature, and size so similar at different ages and in different groups, that it is impossible to explain them away as due merely to education or experience." They infer that these differences are innate in the sense organs or nervous structures. Yet they admit the evidence is inconclusive. From a study of the data presented, the writer sees no reason for concluding the differences are not traceable to education, environment, etc. Probably the color-blindness studies give us the most positive evidence of inherited differences.

In the simple motor processes, tests were made of tapping, dealing cards, simple reaction time to sound and light. In these the boys were faster than the girls, though the differences were small.

The simple perceptual and motor tests were made more complex by elaborating the processes of comparison which most of them involve, thus increasing the coefficient of intelligence. In the bisection, trisection, and proportioning of lines, the boys excel the girls. In the irregular dotting, card sorting, alphabet, writing, reading and

counting for speed, the girls excel the boys. In the solution of mechanical puzzles, which Miss Thompson calls ingenuity tests, the boys excel the girls. It does not seem to the writer that the factors of interest, training and experience have been considered in these experiments.

In the scope of attention and the maintenance of attention, as tested by the McDougal spot pattern and iregular dotting tests, the boys and men were found superior to the girls and women. These data are in conformity with the mental pathology of the sexes. In the female we find the greater number of cases of "hysteria, of split consciousnes, dissociated personality and mental conflict."

The mirror and memory tests were used for the prime purpose of determining the ease with which *new associations* are formed. The results of the first were contradictory. In memory, the female is superior. This is true at all ages and in all of the tests used by the authors, and for this reason they consider this difference innate. For the teacher, it means that the girls "assimilate" more rapidly than the boys.

For testing the speed with which *old associations* were reproduced, the methods of free and restricted association were used. In both of these the males were superior.

An attempt was made to test the vividness of the imagery by two methods, the objective and the introspective. In the former a series of objects were shown, series of noises made, or movements made, the subject then writing as many as he remembered. In the introspective method, "the subjects were questioned, according to a prearranged order, as to the vividness with which they could imagine certain experiences and required to arrange them in a corresponding order." The girls seem greatly to excel the boys in visual imagery; the boys are superior in auditory and motor. From the introspections of the students, and adults, the authors infer that while differences of type of imagery play little part in purely intellectual processes, they may have some influence upon moral characteristics. Visualizers see their friends, their acts, as present. Non-visualizers found that out of sight means to forget, to be out of mind.

The reasoning processes were tested by the completion of argument, analogies, sentences, opposites and the correction of syllogisms. The sex differences were not quite three times the probable error and are therefore negligible. An American experiment performed with 757 children under Thorndike gives the same results. Cohn and Dieffenbacher find with one exception little difference in the sexes. This exception is the critical tendency of the boys, shown by the frequency with which their answers, especially the wrong ones, are given with reservations.

Believing that "Mental behavior is determined largely by emotional capacities," Burt and Moore think too little attention has hitherto been paid these qualities. Such tests as have been used have been mostly physical in their nature, and are open to the objection that they do not make due allowance for the greater physiological activity of man. While the authors have used the pneumograph and sphygmograph and also the psychologalvanic reflex, the last with the best results, they find them unsatisfactory.

They attempt to study the emotional elements from their effect upon mental processes such as memory, attention, etc. Ambiguous words and pictures are given, from the selections and arrangements of which, it is learned that boys at an early age have greater interest in animals and things; girls, in persons. A little later, the boys prefer pictures of the opposite sex while girls desire the pictures of

little children. Thus they find a particular mode of apperception and grouping for each sex. Using the continuous association tests of Jastrow, on children and adults, English, Hebrew and Chinese, they find women more subjective and personal in their tastes, men more objective and impersonal. Applying the discrete association tests, they find girls more emotional than boys. From questionnaires Dr. Heymans found woman "has stronger emotionality, greater activity, probably a stronger moral disposition and a greater tendency to secondary functions."

The nature of the emotions and objects arousing them differ at a very early age, and this difference under the influence of heredity and environment continues to increase, though it never equals the physical sex differences. So far as innate the emotions are rooted in the instincts connected with reproduction.

How then do the results of the data fit in with the various theories propounded?

In addition to the subjects mentioned, some of the tests were applied to 1,000 children and to adults of various social status and nationalities, with these general results; every test appears to differ with age, race and status; many of the sex-differences are the *same* in the various environments, ages and nationalities,—these are considered the most important and are assumed innate.

Such differences as have been found may be due to differences in nervous systems, neurones, synapses, or general structural differences. Such differences could be inherited. If, as in color-blindness, we may consider these sex-differences unit-characters, we could explain their limitation to one sex.

Physiological functions may by natural selection determine special characteristics through direct inheritance of those qualities most useful. Variation of the reproductive organs means variation in the development of the glands, pituitary, adrenal, thyroid,—this affects temperament. Woman's life contrasted with man's is largely visceral, man's, muscular.

Practically all of the tests demonstrate that the simpler the process, the greater the sex-difference,—the higher the correlation with intelligence the less the sex-difference. In very few cases, is degree of difference as great as is commonly accepted. The similarities seem about as frequent as the differences. Thus it seems to the writer that the authors have expressed, for the pedagogue, the gist of the whole matter in a quotation from Miss Thompson: "the question of the future development of the intellectual life of woman is one of social necessities and ideals, rather than of inborn psychological characteristics of sex."

GEORGE E. JONES

BOOK NOTES

"Till Teorien för Föreställningsforloppet" (contribution to the Theory of the Ideational Process), by G. A. Jaederholm, is a recent study, published in Swedish in the Scandinavian psychological journal, *Psyke* (Upsala, 1912, pp. 170-260). The article is largely historical and critical. It covers such topics as Wundtian "apperception," Ziehen's "constellation," "perseveration," the motor component in G. E. Müller's memory experiments, James' criticism of the individuality of *Vorstellungen,* Binet's description of thought, von Kries' contribution to the theory of *Einstellungen,* the thought-psychology of the Würzburg school, Jung's *Tatbestandsdiagnostik* and its critics, and Freud's theories of the functions of emotional complexes, concluding with a criticism of the Freudian theories. The author's position is thus stated in his own words: "Psychoanalysis is the beginning of a method for the investigation of egocentrically oriented ideas, which undoubtedly can become extremely fruitful for the normal differential psychology. But many of the far-reaching phantasies in interpretation, to which it has given rise, are helplessly uncritical and cry for the purging fires of normal psychology. What may remain after such a normal psychological control investigation no one at present knows." A good bibliography accompanies the paper.

In the above mentioned journal, the same author has a paper on the psychology of color perception ("Till Färgvarseblifningarnas Psykologi"), which is chiefly a consideration of David Katz' study, "Die Erscheinungsweise der Farben und ihre Beeinflussung durch die individuelle Erfahrung" (*Zeitschrift f. Psychol. u. Physiol. der Sinnesorgane,* Ergänzungsband nr. 7, 1911). A. N. GILBERTSON

The current issue (May, 1913) of the *Svenskt Arkiv för Pedagogik* (edited by B. Hammer, professor of pedagogy in the University of Upsala) contains articles on "Character Building in the School," by L. Levander, dealing largely with experiments in pupil self-government; "The Interest in School Subjects among Gymnasium Studen," by J. O. Nordlund, comparing the results of previous studies with those of a recent investigation by the author; "A Contribution to the Psychology of Good Writing," by E. Westberg; "Standpoint and Methods of Pedagogical Researches Concerning Teaching," by H. Forsberg, in which the author holds that psychological researches under laboratory conditions should be supplemented by investigations of a purely pedagogical purpose, in the school and the home, and emphasizes the training in civic and vocational lines as of paramount importance; and lastly, a discussion on "Personal Initiative and Causality in History," by G. Setterberg K. Nordlund. The editor gives a resumé of William Stern's "Differentielle Psychologie."

A. N. GILBERTSON.

The Sleep of School Children: Its Distribution according to age, and its relation to physical and mental efficiency. Parts I, II and III. By LEWIS M. TERMAN and ADELINE HOCKING, M. A. *Journ. of Educa. Psychology,* March-April-May, 1913. pp. 138-282.

The author first deals with the distribution of sleep according to age, then its relations to intelligence, to school success and to nervous

disorders, and lastly with the conditions of children's sleep. It constitutes a real addition to our knowledge of this subject.

The Psychology of Laughter. By Boris Sidis. New York, Appleton. 1913. pp. xii., 300.

The preface contains the following significant sentence: "All citations, however, from these two American writers (Bret Hart and Mark Twain) had to be dispensed with, because their publishers' permission could not be obtained."

The book itself contains 27 chapters and is essentially an original work. The author has made very little use of the literature on the subject of laughter but the book is very rich in well chosen selections.

Educational Dramatics: A handbook on the educational player method. By Emma Sheridan Fry. New York, Moffat Yard & Co. pp. 69.

Mrs. Fry, as we understand her, has attempted to carry on the splendid work done years ago by Miss Hertz, and she here gives an interesting review of her method of treating dramatics. There are examples of the educational use of the dramatic instinct, public performances, and a chapter on the player and the part. Besides continuing the work of Miss Hertz, Mrs. Fry has established an institution for the training of candidates for the stage.

The Way to the Heart of the Pupil. By Dr. Herman Weimer. Tr. by J. Remsen Bishop and Adolph Neiderpruem, with special author's preface for American readers. New York, Macmillan. 1913. pp. xii., 178.

This book found so enthusiastic a reception in the land of its origin that it is here presented in English. The assumption is that love and not fear is the method of education. Some critics have said that to carry out such a scheme as is here discussed every teacher must be a Pestallozi, others have thought the child was idealized. The topics stressed are, the power of love, the influence of personality, patience and confidence, the punishing power, school appearances, uniformity and individuality, school and home.

The World's History at a Glance from 800 *B. C. to* 1913 *A. D.* In synchronous form, together with abstracts of Bible history and Greek and Scandinavian Mythology, with comprehensive tables and biography, showing the rulers, statesmen, eminent personages, principal events, discoveries, inventions, etc., with dates thereof, and maps of various countries. Compiled and edited by Joseph F. Harrington and assistants. Boston, The Ball Publishing Co. 1913. pp. 66.

This is an extremely convenient conspectus of universal history. We have quite a collection of such, but this impresses us as on the whole far and away the best thing of its kind, as indeed it ought to be, since it is the last; but others have been so good that this praise really means a great deal.

The Shattered Halo and other Stories About Schools. By C. W. Bardeen. Syracuse, N. Y., C. W. Bardeen, 1913. pp. 250. Price $1.

This must be the eighth or tenth volume of stories about teachers, pupils and school-life by this author, whose simple but interesting tales go to the heart and present a very vivid picture of contemporary American education from the standpoint of a man who has been vitally connected with it for many years. The author of this note has read all Mr. Bardeen's stories and deems this the best of the series.

The New Education in Religion: With a curriculum in Jewish Studies. By HENRY BERKOWITZ, D. D. Philadelphia, The Jewish Chatauqua Soc., 1913. pp. 128.

Deuxième Étude sur la Mémoire Logique: La Reproduction Après Des Intervalles Temporels de Différentes Longueurs. MM. A. MICHOTTE & TH. PORTYCH. Louvain, Institut Superieur de Philosophie, 1913. pp. 363.

Vorlesungen zur Einführung in die Experimentelle Pädagogik und Ihre Psychologischen Grundlagen. VON ERNEST MEUMANN. Zweiter Band, mit 39 Figuren im Text und 1 Tafel. Zweite Umgearbeitete und Vermehrte Auflage. Leipzig, Von Wilhelm Engelmann, 1913. pp. XIV., 800. Price-Mk. 12.25.

Greek Lives from Plutarch. C. E. BYLES, B. A. (Theseus, Lycurgus, Aristides, Themistocles, Pericles, Alcibiades, Dion, Demosthenes, Alexander.) New York, Longmans, 1907. pp. 232.

A First Book of Composition for High Schools. By THOMAS H. RIGGS and ISABEL MCKINNEY. New York, Ginn & Co. pp. vii., 300. Price $.90.

Primary Artisan Education. By W. P. WELPTON, B. Sc. New York, Longmans, 1913. pp. xix., 252. Price $1.25 net.

Aesthetic Education. By CHARLES DEGARMO. Syracuse, C. W. Bardeen, 1913. pp. xi., 161.

China Revolutionized. By JOHN STUART THOMSON. Indianapolis, The Bobbs-Merrill Co., 1913. pp. 590.

Educational Psychology. Volume I: The Original Nature of Man. By EDWARD L. THORNDIKE. New York, Columbia University, 1913. pp. xii., 327.
Review will follow.

The Growth of Responsibility and Enlargement of Power of the City School Superintendent. By ARTHUR HENRY CHAMBERLAIN. Berkeley, Cal., University of California Publications. Vol. 3, No. 4. pp. 283-441. 1913.

The Factors that Influence the Sensitivity of the Retina to Color: A Quantitative Study and Methods of Standardizing. By GERTRUDE RAND, Ph.D. Princeton, N. J., The Psychological Monographs. The Psychological Review Co., 1913. pp. xi., 166.

NOTES

Report of the Polish Child Study Association for the year 1912.— In the course of the past year, scientific research on the development of children has been a prominent subject of discussion, not only in the Polish Society for Child Study, but also in other societies in Warsaw. The Society of Preparatory Teaching arranged a series of meetings principally devoted to the analysis of different phases of the mental activity of children. Dr. Ioteyko now of Brussels, but a Pole, lectured on "Pedology in Pictures" making use of a great many pictures to illustrate the method and results employed in child study. At the Warsaw Hygienic Association Dr. T. Javoszyuski discussed psychological research in schools and some results of his own studies. Dr. A. Cygielstreich presented at the Polish Psychological Association, his study on Children's Subconscious Creativeness. In one of the autumn numbers of "Education" Professor J. W. David discussed the term Pedology. In his opinion, this expression is unnecessary and he proposes to keep the terms chiefly used in America, England, France, etc., *i.e.,* Child Psychology or Experimental Psychology. Miss Szyc, in the October number of "The Philosophical Movement" tried to show the genesis of child study and its manifold terms.

The year 1912 was marked by a decided tendency to popularize systematic and solid study in this branch of psychology. In the University of Brussels Dr. Ioteyko established international pedagogical courses with a high scientific standard. At Cracovie (Galicia) at the second meeting of neurologists and psychologists Miss Szyc lectured on the verbal and grammatical peculiarities of children's language between the fourth and ninth years. Dr. Beaurarain (Porarin, Galicia) read on "The Symbol." This was almost exclusively on children's speech, comparing some of its peculiarities with similar ones in the speech of primitive peoples.

On February 11, 1912, a branch of the Polish Child Study Association was opened in Lodz. In the beginning of the school year 1912-1913, a questionnaire was sent to the members of the society for working out themes for the study of speech. It was decided that there was an urgent need of organizing a series of systematic lectures on child study, but in consequence of many hindrances this plan was put off until next year.

In the fall of the year 1912 Mr. T. A. Koziava established a new periodical "The Educational Review," and Professor H. Matzke (artist), a quarterly review, "Form and Color," which contains valuable contributions for the study of the aesthetic development of children.

At the meetings of the Child Study Association during 1911-12 the following papers were presented: Professor K. Appel, The Development of Children's Language with Reference to the Vocal Organs; Miss Szyc, Answers of Children from Four to Nine, to the question "What is this?" Jarvs' Experiments with an aesthesiometer on school children (Mr. Jarvs found a correlation between sensitiveness and intelligence. Intelligent children are more sensitive); Mrs. Heymans, Creative Powers of Children. (Mrs. Heymans presented her observations of a child with a poetical disposition during the years six to ten); H. Wavxzavska, Subconscious Creativeness of Children,

an experimental study from the Warsaw Psychological Laboratory; (Postal cards served as material. Children were asked to describe them and eight days later to report this from memory. Comparison of the results showed most frequently that the second descriptions were full of particulars which had not been on the pictures); Dr. Sikorska, Studies on Physical Development of School Girls; Miss Szyc, New Ideas and Works in the Studies of Intelligence of Children. (A sketch of lectures by Stern, Meumann, reports of attempts by American psychologists to complete the Binet theory, and remarks on Polish works in this line); Mrs. Grudinska, The Money Sense of Children. (This work was based on Will Monroe's syllabus and is the result of over 800 answers from children of all parts of Poland); Mrs. Grudinska, Self Government. (Here the self government experiments in America were presented, including the George Jr. Republic in Freeville, Gill's experiments in the United States and Förster's movement in Switzerland); Miss Majevska, a Study on School Compositions. (All these compositions were quite spontaneous and came principally from children from elementary schools from seven to twelve of age); Mrs. Lubliner, Report of the Congress in Bern (treating the question of abnormal children. Dr. L. Wernic, New Methods of Medical Inspection of School Children); Mrs. Silber, Children and Pictures (a study of the Capacity of Aesthetic Judgment in Children (showing that it can be developed by training).

During 1912, the Committee for the Study of Speech Development held three meetings. The work of the Committee during the year was centered on the study of the language of children from seven to eighteen years.

The Committee for the study of the character development of children held three sessions chiefly devoted to the revision of two questionnaires.

The Committee for the Study of Children's Drawings. The object of studies on children's drawings sent in as an answer to the two questionnaires printed in 1907 and 1909 was to show the psychological and educational value of this work. Mrs. Grudinska undertook the work of arranging, tabulating and determining results. A large number of spontaneous drawings have been collected and will be completed during the year 1913. These consist in answers to the second questionnaire.

The Polish Child Study Society sends its deepest and warmest thanks to the editor of the PEDAGOGICAL SEMINARY for printing its report, to Dr. Louis N. Wilson, and Theodate L. Smith, Secretary of the Children's Institute, for their continual aid and kindness.

ANNA GRUDZINSKA

Svenskt Archiv för Pedagogik (Swedish Archive for Pedagogy) is a new quarterly journal published at Upsala, the first issue of which bears the date of October, 1912. It contains 120 pages. The price is 5 kronor (about $1.35) per annum.

The object of the journal is to be the organ for pedagogical research in Sweden. It will contain scientific studies in the various fields of pedagogy and related disciplines. Problems will be treated partly in original articles, partly in critical reviews of prominent pedagogical writings. There will be also reports of the more important activities and developments in pedagogy in various parts of the world.

The editor is Prof. Bertil Hammer, of the chair of pedagogy in the University of Upsala. The list of collaborators includes the names of over two score teachers and other workers in both the academic and the administrative branches of the Swedish educational

system. Resumés of important articles will be given in German, French, or English, thus partially at least making the contributions accessible to the vast majority of students, to whom the Scandinavian languages are a sealed book. The contents of the first number and the announcements of forthcoming contributions promise well for the character and value of the journal. Students of education everywhere will welcome this new endeavor to advance the study of pedagogy on strictly scientific lines in a country which, together with its sister nations of the Scandinavian culture-group, Norway, Denmark and Finland, has long been an object of admiration by the whole world for its excellent system of public education.

In his introductory statement, the editor points to the fact that the new empirical pedagogy had its beginnings in "the practical America," with the work of Dr. G. Stanley Hall. "In the course of two decades," observes Prof. Hammer, "Stanley Hall has succeeded in making the empirical psychology and pedagogy subjects with secure homestead rights in the educational life of his vast native land." He expresses also the debt of the science to other American investigators, of whom he mentions Dewey, Earl Barnes, Monroe, Russell, Chamberlain, Cattell, Donaldson, Sanford and Scripture.

Of European authorities in this field he names as most prominent the late Alfred Binet in France and Ebbinghaus, Lay, Meumann and Stern, besides Wundt, to whom belongs the honor of having laid the foundations in experimental psychology.

The Finnish University of Helsingfors was the first institution in the North to establish a professorship in pedagogy, though at the time of its founding it does not seem to have had any connection with the new psychological science. In Sweden there are now chairs of pedagogy in both of the state universities (Upsala, 1908, and Lund, 1912). In Norway and Denmark, while there are no separate chairs in the national universities, the professors of philosophy and psychology, Aal in Christiania and Höffding and Lehmann in Copenhagen, have made valuable contributions of pedagogical significance.

The leading article in this number, on children's ideals, has already been reviewed in the PEDAGOGICAL SEMINARY.

ALBERT N. GILBERTSON

Reasons for Exploiting Metrical Literature in Schools.—The article in the December number of the PEDAGOGICAL SEMINARY by Mr. Webster on "Versemaking in Schools" lacks, in my opinion, an important direction to the teacher who would be glad to follow Mr. Webster's suggestion for the purpose of adding a legitimate interest to school exercises in literature. Also Mr. Webster disregarded if he did not fail to recognize an opportunity to rate at its true and generally overestimated value metrical literature as compared with prose. He quotes the efforts of pupils to construct metres but does not insist on a prime value of this exercise, showing the pupil through his own experience how impossible it is to say just what you mean with the exigencies of rhyme and metre. Such an exercise as he describes should not be given, I think, without some class discussion of the advantage of prose over poetry for adequate and exact communication. Otherwise this interesting exercise may confirm in habits of inexact thinking the pupil who is repeating race history in showing an aptitude for metre; for instance, if a pupil has put a psalm into metre, he should be asked if the morality of the psalms would be more or less authoritative if the author had used prose instead of poetry as his method of communication. One reason that the article interested me was that I was formerly connected with the Commercial Depart-

ment of the Central High School, Springfield, a department which Mr. Webster now serves in the new High School of Commerce. I still have in my possession some notes made for a lesson plan when teaching Poe; in them I demonstrate the fact that rhythm is a racial instinct, and give as examples the responses of the Delphic Oracle, keeping time unconsciously to march music, and the historic "Eeeny meeny, mony, mi." I chose Poe as the author with whom to correlate this instruction because he explains at length his own tricks of composition, and is skillful in the use of metres. I remember that my class by making some original metres acquired considerable respect for Poe's ingenuity; also they learned to read poetry aloud better. This was tested soon after by the Indian names in "Hiawatha," which they found less troublesome than those classes had that had not studied Poe. I hope this exercise increased their respect for metrical ingenuity and lessened their adolescent emotion toward poetry. They were young enough to like poetry but they were old enough to be taught better. The result was, I think, quite different from that to be expected in accordance with Macaulay's definition of poetry, quoted by Mr. Webster; Macaulay claims that the rudest form of language is the most fit for poetry, which is particular rather than general. My pupils learned that poetry is highly artificial, has always been so. A modern instance is such a poet as Austin Dobson or Swinburne; but Macaulay might have quoted examples as illustrative. His statement that poetry deals with the particular rather than with the general is denied by the poet whom Mr. Webster quotes for testimony as to the poetic nature of boyhood: Wordsworth says: (Poetry)'s object is truth, not individual and local, but general and operative.

One of the subjects of the eminent German Professor Eucken when lecturing in this country was "The Philosophy of Goethe;" this included Goethe the poet. There are several accepted definitions of poetry from which instances will readily present themselves to prove that poetry may be general; it certainly must be so if Matthew Arnold was right in calling it "a criticism of life," and his is a definition in good use. It seems to me a good plan to use metrical exercises in schools for the sake of taking advantage of a natural inclination, and to prove the careful workmanship of standard poetry, also, to show the defects of metrical expression from the point of view of exact communication; and this is the direction needed by the teacher to whom Mr. Webster has in general addressed himself. Just as long as pedagogical adults despair of the boy that finds Milton indirect, the teacher will need to be reminded of the spurious nature of poetry. We do not help our case of claiming that literature is worthy of the pupil's consideration by forgetting such defects. A Yale instructor (H. S. Canby, "Education," Nov. 1908), says that poetry is "the expression of the highest thoughts of the race in their best form," and that is a common definition that I would refute. We certainly can't mean what we say when we say this. Or is it time for an investigation to find out how many English teachers do believe such nonsense? Surely the permutations and combinations of metrical syllables can not be entrusted with our highest thoughts and all of them! It is arithmetically impossible. Since legislation has attempted to improve spelling, it is not impossible that a language may be legalized to substitute in poetry words of convenient syllabic arrangement for our inconvenient forms. But at present sense must often be sacrificed to sound in poetry.

A general lack in Mr. Webster's paper seems to me that of failing to state accurately the value of this combination of words known as

metre. Such an attitude as that of the Yale instructor seems to me dangerous. Prof. Robinson of Columbia in his book, "The New History" says that we teach the young to revere the past too much; we should exploit it for the benefit of the present. A similar need to exploit poetic literature seems to me important. As a matter of fact the poets may truly claim:

"—we are the movers and shakers
Of the world forever, it seems."

But it is a pity that they are; for as it can be made evident to any pupil, if not surmised by him, poets say what they have to, to meet the exigencies of poetry. It happens that they have said some very beautiful and useful things. Prose also may appeal to the aesthetic sense.

Teachers certainly do not wish to encourage the taste for inexact expression, though in the form of metre, to become permanently racial. Inexactness of human communication is one of the disadvantages thus far common to the race which it is trying to overcome.

Macaulay, whose definition of poetry forms the introduction to Mr. Webster's paper, is a writer whose form even in prose is superior to his matter, indeed dominates it, the most vicious quality of literature. Judged by the moral standard of human communication, all poetry is vicious. If the teaching of English is to make educative concessions to the pupil's unconventional and enlightening estimate of authors, a little exploiting of poets will be useful.

In a book on "The Enjoyment of Poetry" by Max Eastman, formerly associate in philosophy at Columbia I find this statement: "From . . . their standpoint, the standpoint of practical sagacity, the statement ascribed to Tolstoy that 'nothing was ever said in poetry which could not be better said in plain language' is entirely true. But from the standpoint of one who wishes to experience the intrinsic nature of a thing spoken of, it is entirely true that nothing was ever said in plain language which could not be better said in poetry." I think that Tolstoy's statement as originally meant is sound. Mr. Eastman believes that to enjoy poetry one should write it, as he does. I have tried that and still am prejudiced against most pedagogical attempts to cultivate an appreciation of poetry.

LUCY HEALD